Research Product 91-01

Range Target System (RTS) Operations Manual

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Fort Bliss Field Unit
Systems Research Laboratory

U.S. Army Research Institute for the Behavioral and Social Sciences

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Range Target System (RTS) is a high-fidelity engagement simulator. Short Range Air Defense (SHORAD) and Forward-Area Air Defense System (FAADS) crews employ their actual weapons in simulated or live fire engagement of sub-scale, fixed-wing and rotary-wing aircraft. RTS permits training and evaluation of individuals, crews, and platoons, provides detailed crew performance scoring and feedback, and can be moved from one location to another and rapidly put in place for a new training exercise or test application.

This operations manual describes the major RTS components (targets, range control station, data acquisition station, position-location station, and laser ballistics simulator), RTS set-up procedures, RTS system preparation and installation procedures, and RTS operations, maintenance, and supply. Two separately published annexes to this manual exist. Annex 1 describes the Pop-Up Target System operations and maintenance. Annex 2 describes the Flying Target System operations and maintenance. These three manuals provide the maximum documentation necessary to support RTS.

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Research Product 91-01

Range Target System (RTS) Operations Manual

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Human Factors in Training
Operational Effectiveness

FOREWORD

The Crew Weapons Performance Team of the Fort Bliss Field Unit of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) performs research and development to improve soldier-system effectiveness in air defense. This research effort is supported by the Realistic Air Defense Engagement System (RADES), a sub-scale facility that realistically simulates critical aspects of the forward area engagement environment. To address air defense training and evaluation deficiencies, U.S. Army Air Defense Artillery School (USAADASCH), U.S. Army Missile Command Target Management Office (MICOM-TMO), and ARI combined to integrate RADES target presentation, performance measurement, and engagement simulation capabilities into the Range Target System (RTS) and to validate crew engagement standards in the RTS. The RTS is a high-fidelity engagement simulator. Short Range Air Defense (SHORAD) and Forward Area Air Defense System (FAADS) crews employ their actual weapons in simulated or live fire engagement of sub-scale, fixed-wing and rotary-wing aircraft.

This ARI Research Product is an operations manual for RTS, describing the major RTS components, set-up procedures, operations, maintenance requirements, and supply.

Development and validation of the RTS was initially authorized by a Memorandum of Agreement between USAADASCH and ARI, subject "Realistic Air Defense Engagement System Applications," dated 14 February 1986.

RTS was demonstrated to the proponent, COL Whitley, Director of Training Development, USAADASCH, on 25 September 1989. RTS was also demonstrated for COL Bridgewater, OSD ADA T&E, 27 September 1989; Mr. Estorga, Technical Advisor, TEXCOM-ADAB, 8 November 1989; and COL(P) Hardy, 7th ATC, FRG, 4 December 1989.

LTG Crosby, DCG-T, TRADOC, approved the development and validation of SHORAD engagement standards by ARI in the RTS (SHORAD Weapon Systems Program Review, 26 October 1988). BG Custer, Assistant Adjutant General, NM ARNG, approved the use of RTS to provide individual and collective training for New Mexico National Guard SHORAD battalions (letter dated 25 May 1990).

EDGAR M. JOHNSON
Technical Director

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RANGE TARGET SYSTEM (RTS) OPERATIONS MANUAL

Introduction

Manual Format

Introduction. This chapter begins with a description of the format and use of this manual. This chapter also describes the RTS, its major components, and the performance feedback generated by the system. The chapter concludes with a list of the primary procedures in the order in which they are conducted. These procedures are referenced according to where they are described in the manual.

RTSETUP. This chapter provides information on how to create scenarios and scenario sets. Interactive menus used with the RTSETUP program are shown and described. Also included is information on the specification of conditions and constants to be enforced during training applications.

System Preparation and Installation. This chapter provides information on getting the RTS ready for use. Instructions are provided on choosing a location for the RTS, unpacking the equipment, emplacing the RTS components, connecting the RTS stations, registering the locations of RTS components, and energizing the RTS stations.

Operations. This chapter explains the sequence of procedures performed during the conduct of an RTS training application. System start up, operate, and shut down procedures are described. Interactive menus used during operations are presented and described according to each of the system stations. Subsections include information on energizing the system, testing and calibrating system components, initializing scenarios, performing realtime operations, and post-processing data.

Maintenance and Supply. This chapter provides information on obtaining maintenance service and support. Included is information about contractor-provided maintenance and available customer support assistance. Also included are recommended supplies and related vendor documentation on the various components provided with the system.

Glossary. This chapter provides definitions of terms and acronyms used throughout this manual.

References. This chapter provides a bibliography of citations.

System Description

RTS is a high-fidelity Short Range Air Defense (SHORAD) engagement simulator. RTS is used to conduct Engagement Simulation Exercises (ESX) or Live Fire Exercises (LFX) for 16-Series Military Occupational Specialties (16P, 16R, 16S). Thus, RTS can be employed using the Chaparral Missile System, the Product Improved Vulcan Air Defense System (PIVADS) or the Basic Vulcan Gun System, or the Stinger Man Portable Air Defense System (MANPADS), respectively. 16P, 16R, and 16S trainees, PFCs, SP4s, and SGTs, and 16P and 16R SSGTs are responsible for engaging enemy aircraft. As of December, 1987, these personnel constituted 56.5 percent of all enlisted air defenders. The RTS, designed to be a crew engagement training and evaluation system for these personnel, can therefore address the training requirements for over half the air defense population.

RTS has the capability to be moved from one location to another, and be rapidly emplaced for a new training exercise or test application. RTS allows the training of individuals, crews, and platoons, and the evaluation of individual task performance and collective crew summary performance. RTS also provides detailed crew performance scoring and feedback, which can be either scenario-specific or averaged over several scenarios.

RTS can be used in combination with air defense engagement range tables provided with the system to enable the qualification of SHORAD and Forward Area Air Defense System (FAADS) personnel. These range tables are based on difficulty-scaled scenarios and approved performance standards. Using RTS along with the range tables enables the evaluation of soldier strengths and weaknesses, and aids in focusing subsequent remediation and sustainment training.

RTS is the direct result of five years of field tests using the Realistic Air Defense Engagement System (RADES). This air defense research was conducted jointly by the US Army Research Institute (ARI) and Science Applications International Corporation (SAIC). Through this research, and the subsequent RTS validation effort, RTS and RADES have been shown to be valid test and training simulators. They have generated the data used to derive and validate performance standards for air defense, and have enabled the identification of engagement task workload indices and the subsequent determination of training and test scenario difficulty levels.

Feedback

Immediate feedback on performance is available to the trainee in terms of task performance and engagement outcomes. The same feedback is available to the instructor-evaluator. Feedback is provided for training and test purposes since the instructor, researcher, or evaluator will require continuous task and summary feedback on the exercising troops, and the trainee will require knowledge of results of his responses.

Feedback is needed when any of the following conditions exist: the range tables are to be employed for qualification and certification of soldiers; soldier performance will be compared to standards to identify strengths and weaknesses; the instructor wants to determine the skill level of the soldiers for varying levels of scenario difficulty; research will be conducted to determine experimental effects on performance; or the practicing crew requires knowledge of results to improve engagement performance. The system can operate with the immediate feedback capability disabled if repeated practice without feedback is desired for a given application.

Performance feedback is available for every target presented in a scenario. Feedback on the following squad leader events is provided in terms of target range and elapsed time: detection, identification, and command to engage or cease fire. Feedback on the following gunner events is provided in terms of target range and elapsed time: acquisition, interrogation, lock-on, superelevation, fire, and reattack. Some of these events are weapon-specific. The following collective summary feedback also is provided: identification accuracy, friends and hostiles engaged, engaged aircraft destroyed, friends and hostiles killed, and hostiles releasing ordnance.

In ESX mode, gun systems can be equipped with a laser simulator to permit the scoring of ballistics effects. The laser is mounted on the weapon and runs off weapon system power. Each time the weapon trigger is depressed, the number of bursts, rounds on target, target range, average miss distance, and average hit point are calculated, displayed, and recorded. Additionally, the gunner receives accurate simulation of the tracer round through the sight reticle of the weapon.

Feedback can be provided in both ESX and LFX modes. However, the LFX mode applies only to 20mm gun systems. The only difference in the hardware configuration between ESX and LFX modes is that a bullet counter is included in LFX mode, instead of the laser simulator, for assessing gun system hits. Bullet counter sensing devices relay target hit information to the ground station, located at the range control area, for each burst of fire. Bullet counting devices and services are not part of the RTS system. They are available at live-fire ranges if requested.

Feedback is also provided with respect to target visual effects signatures, which indicate hits levied on a target by an engaging crew. The realtime engagement effects assessment program is able to determine whether or not a kill would occur, given the flight path or position of the target, the trajectory of the round, and the elapsed time since missile or round launch. Kill and hit effects signatures are not released from either stand helicopters or flying targets during LFX applications. When multiple fire units are engaging the same threat in ESX the effects signatures are disabled.

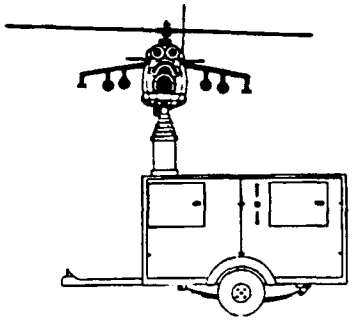
Visual engagement effects signatures are manually released on flying targets by signals transmitted by the pilots. The system operator will order the target pilot to "release effects" if a kill was awarded. The pilot activates a switch on his transmitter, uplinking a command to inject oil into the aircraft's exhaust system. The smoldering oil produces the smoke signature which indicates a "kill".

Effects signatures are automatically released under software program control on all pop-up helicopter targets. The program determines whether the target will be unmasked (i.e., available) at the time of round or missile intercept. The program already knows the helicopter position, and controls when the target will unmask and mask. If a kill is assessed on a pop-up helicopter, the program will automatically send the effects release command to that helicopter. This causes the helicopter to emit the standard smoke signature and to become masked. Smoke and sudden masking indicate a kill. If a miss is determined, a smoke signature will not be evident and the target will remain raised until it receives the prescripted lower command.

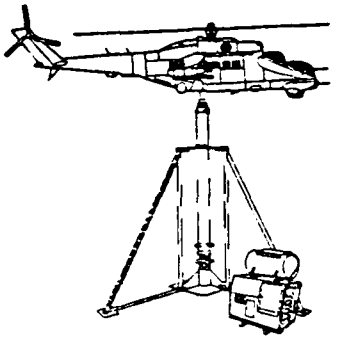
For missile systems, (i.e., Chaparral and Stinger) a kill is awarded if all gunner actions captured from the weapon system are correct (such as acquire, lock, superelevate and fire, for the Stinger). For gun systems (i.e., Vulcan and PIVADS), a kill is awarded according to the number of rounds on target. For a medium difficulty scenario, it takes at least 8 rounds on target to be awarded a kill. The only other factors that can prevent a kill from occurring would be if the target was out of weapon range, was masked at the time of missile or round intercept, or was in the weapon system's dead zone.

Major RTS Components

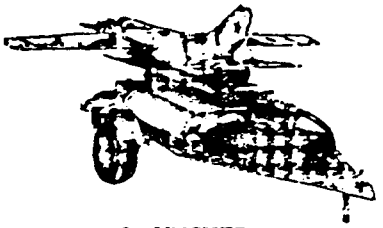
Figures 1 and 2 depict the major hardware components comprising the RTS. The primary components include the Flying Target Systems (FTS), the Pop-up Target Systems (PTS), the Range Control Station (RCS), the Data Acquisition Station (DAS), and the Position Location Station (PLS).



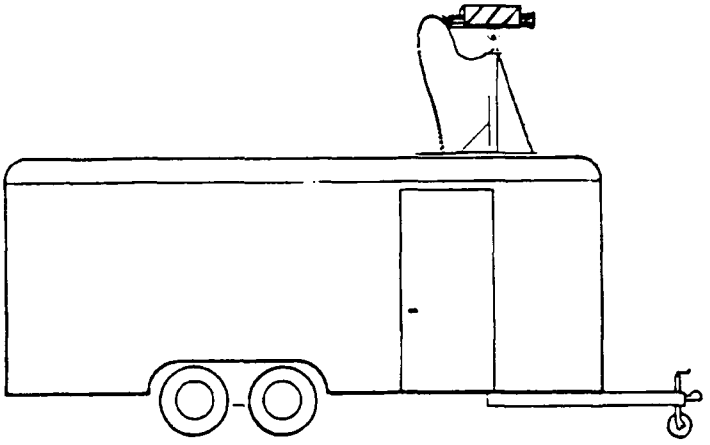
TRAILER MOUNTED PTS



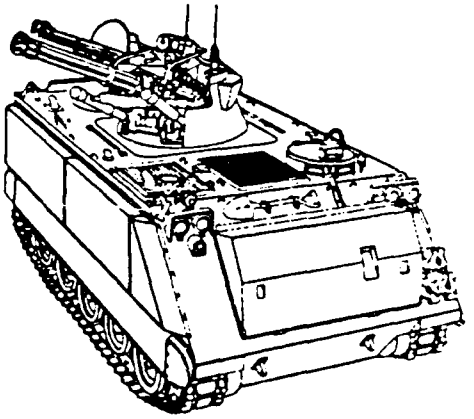
TRIPOD MOUNTED PTS



LAUNCHER
WITH FIXED WING MOUNTED
FTS



RTS CONTROL TRAILER
WITH RCS, DAS, PLS LOADED



INSTRUMENTED WEAPON SYSTEM

Figure 1. RTS major hardware components

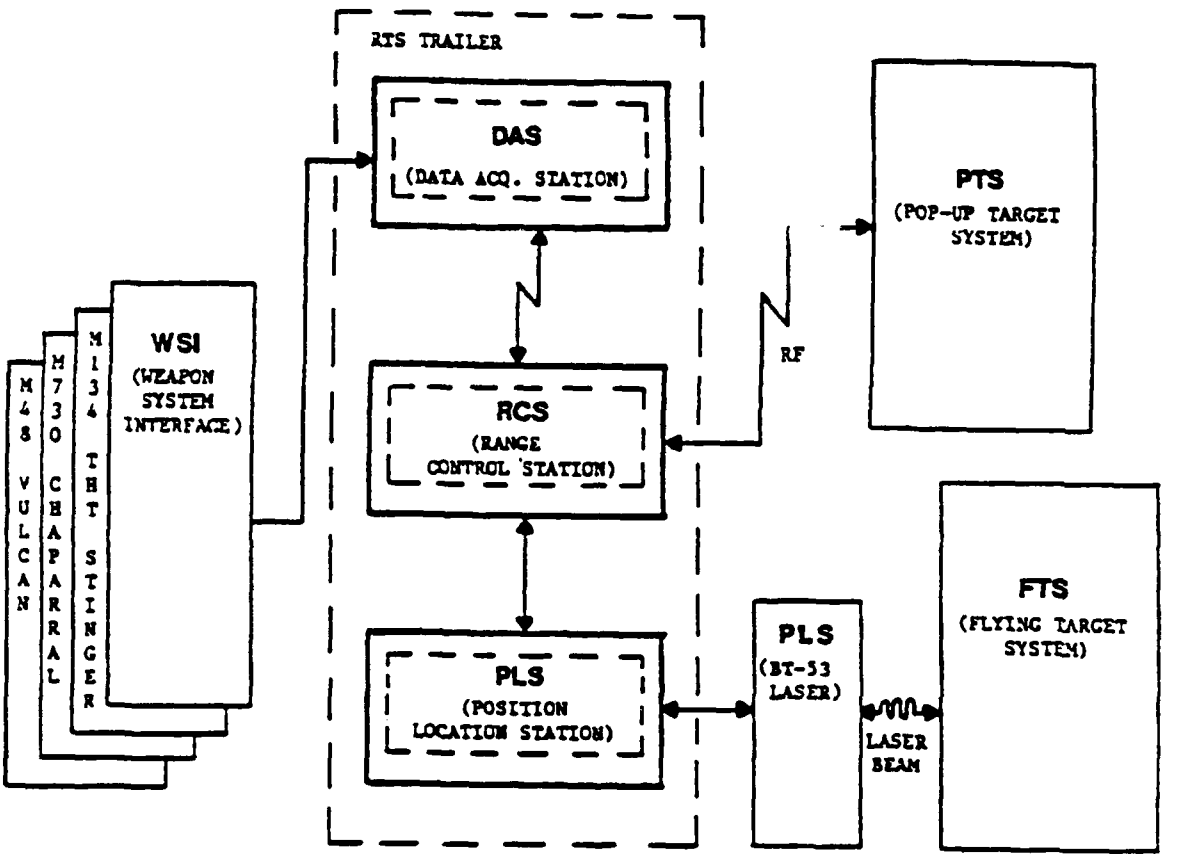


Figure 2. RTS hardware configuration

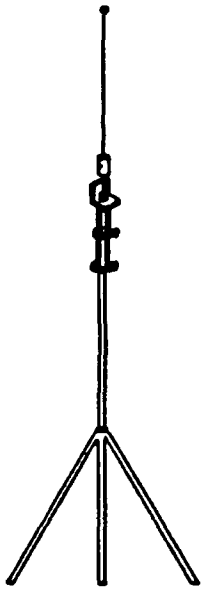
Targets. RTS currently uses 1/5 scale rotary- and fixed-wing targets, although other scales are accommodated. All targets represent actual US or Soviet aircraft. Aircraft are camouflaged, three dimensional, molded fiberglass replicas. They are flown either remotely according to prescribed flight paths and maneuvers or pop-up from designated positions via stand-lift devices.

Scale targets offer several advantages over full scale, the greatest being the cost savings. Scale targets are inexpensive to operate, repair and maintain, and require few resources to support them, unlike full scale aircraft. Scale targets do not have inherent logistical, planning, and time constraints associated with their employment. Thus, they are more dependable. Another advantage is the reduction in range space required (at least 1/5 of the usual space). Further, scale targets are extremely reliable. As many as 30 flights per flying aircraft have been performed with minor repairs. For pop-up targets, their durability may last indefinitely. Due to the smaller size of scale targets and their proximity to the control area, scenarios can be replicated with greater accuracy to ensure consistency, and can be completed in a shorter time to enable maximum training efficiency.

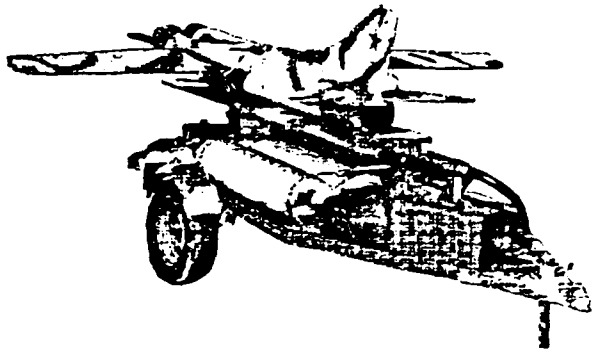
The validity of using scale targets has been established empirically on numerous occasions (Barber, 1987; Drewfs, Barber, Johnson, & Frederickson, 1988). Scale targets elicit engagement performance representative of their full scale counterparts. That is, responses to scale targets were shown to be not significantly different from responses to full scale aircraft, given similar test conditions. Additionally, tests using scale targets have generated equivalent performance results repeatedly, thereby demonstrating consistency over time.

RTS uses 1/5 scale targets for a number of reasons. The 1/5 scale aircraft have greater payload than smaller scales. This enables them to carry special instrumentation necessary for various field test applications. This scale also allows more accurate visual representation without compromising aircraft stability and maneuverability. Further, 1/5 scale allows weapons such as the Vulcan to engage a target at simulated full scale weapon range, without being outside of the normal range envelope in actual distance (i.e., will activate the ready-to-fire indicator at ranges as close as 200 meters, representing 1 kilometer in full scale).

Flying Target Systems (FTS) are radio-controlled miniature aircraft, requiring trained radio control pilots to fly them, and trained maintenance personnel to support them. Figure 3 shows FTS components.

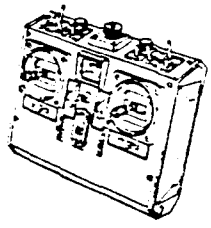


RF ANTENNA FOR AIRCRAFT CONTROL



LAUNCHER WITH FIXED-WING MOUNTED

RADIO



TRANSMITTER FOR AIRCRAFT CONTROL

Figure 3. Flying Target System

Pop-up Helicopter Target Svstems (PTS) come pre-mounted and self-contained in their own towable trailers as shown in Figure 4. Tripod mounted stands, also depicted in Figure 4, are supported by RTS as well. The tripod stands require three men to move them. These pop-up helicopter systems connect to the Range Control Station, where they can be presented under automatic (scenario-driven) or manual (operator-induced) control. Up to 12 PTS can be interfaced at one time (trailer or tripod).

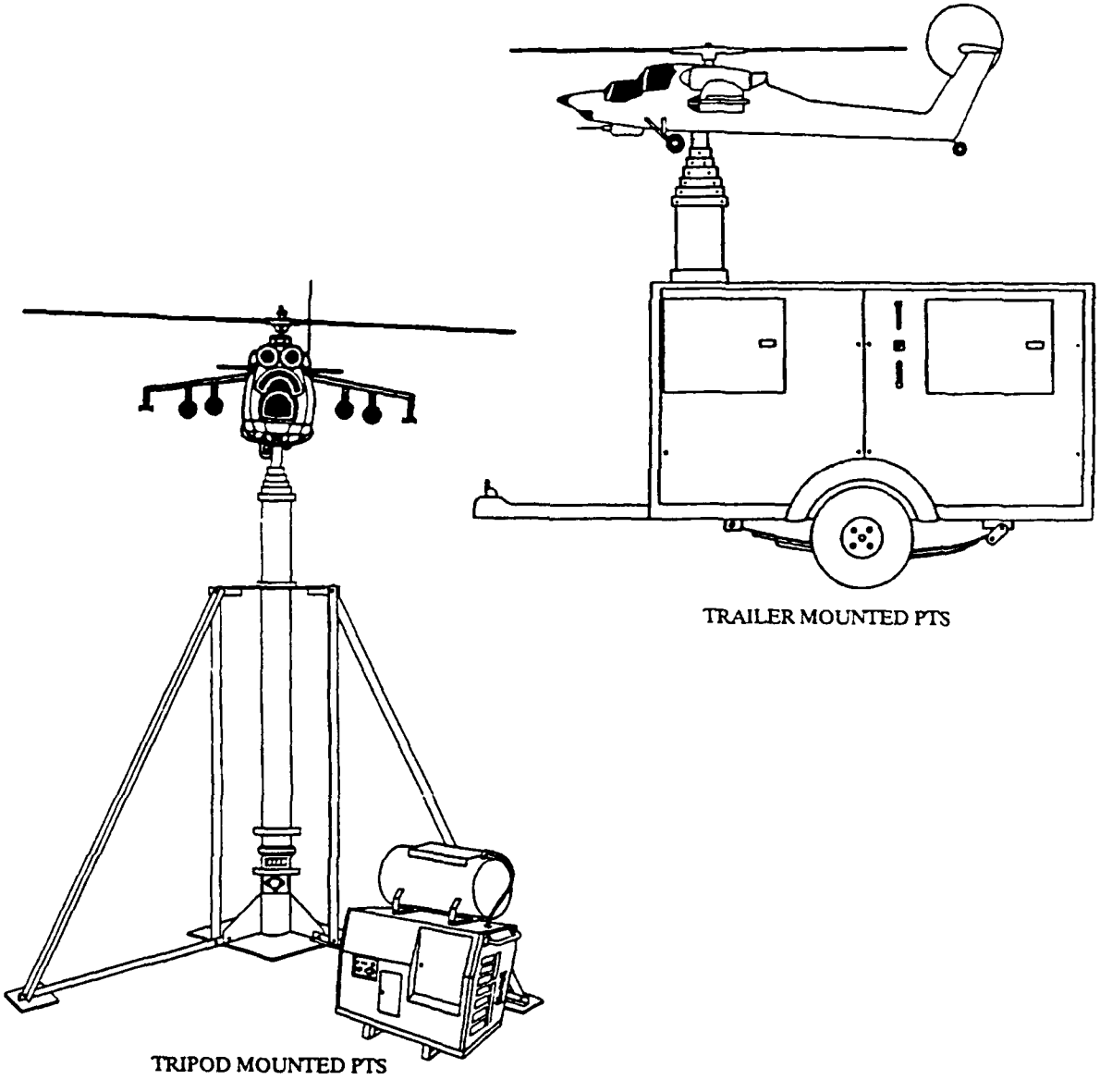


Figure 4. Pop-Up Helicopter Target System

Range Control Station (RCS). The RCS is the central control point for all RTS operations (see Figure 5). The RCS is the station where voice communications, data communications, system test and calibration checks, initialization of the system, realtime functions, performance scoring, and printing are initiated. Because the operator may need to work from a variety of locations, the RCS is portable and allows the user to relocate the base of operations.

The RCS consists of a computer, a hardcopy printer, an intelligent data communications interface, a base station voice radio, and an Uninterruptable Power Supply (UPS). A radio frequency (RF) data communications link connects the RCS with the helicopter stand systems. The RCS is currently connected directly via cables to the DAS and PLS.

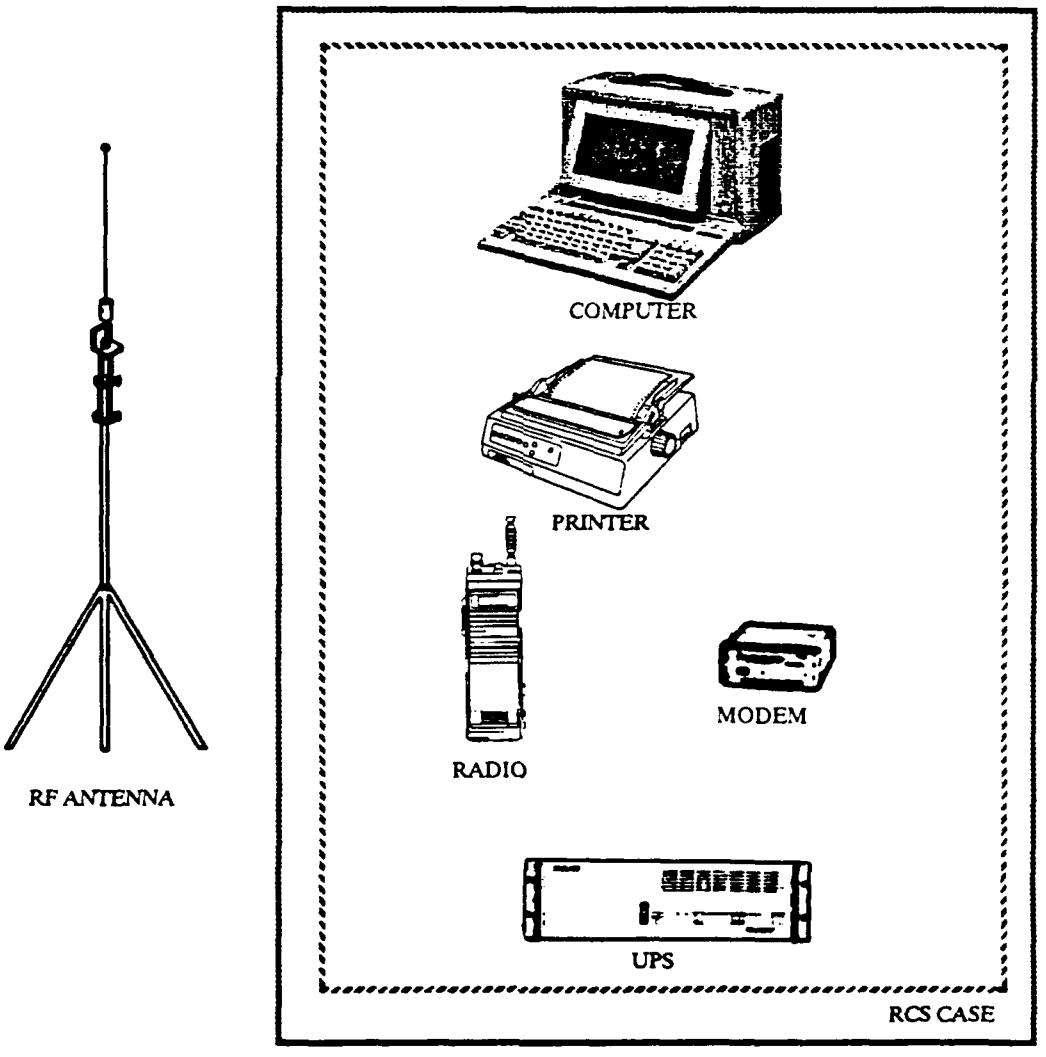


Figure 5. Range Control Station

Data Acquisition Station (DAS). This station captures all of the Squad Leader and Senior Gunner engagement task and weapon events as a function of elapsed time and aircraft range. Effects scoring and assessment of kills are also performed at the DAS. The DAS provides scenario feedback on these events. The DAS consists of a station computer, a Weapon System Interface (WSI), and a UPS (see Figure 6).

The DAS is connected to the RCS for purposes of data communications, using cable or RF data link. The weapon system interface connects the DAS to the weapon system. It handles all critical weapon inputs regardless of the SHORAD weapon system in use. Weapon inputs to the DAS are tested prior to the start of a test or training application using the test panel on the WSI. This device is used to verify that all weapon data acquisition functions at the DAS are operating properly prior to the actual hook-up of the weapon.

The DAS is usually manned by an instructor-evaluator. Up to 8 DAS (i.e., weapons) can be simultaneously supported by RTS.

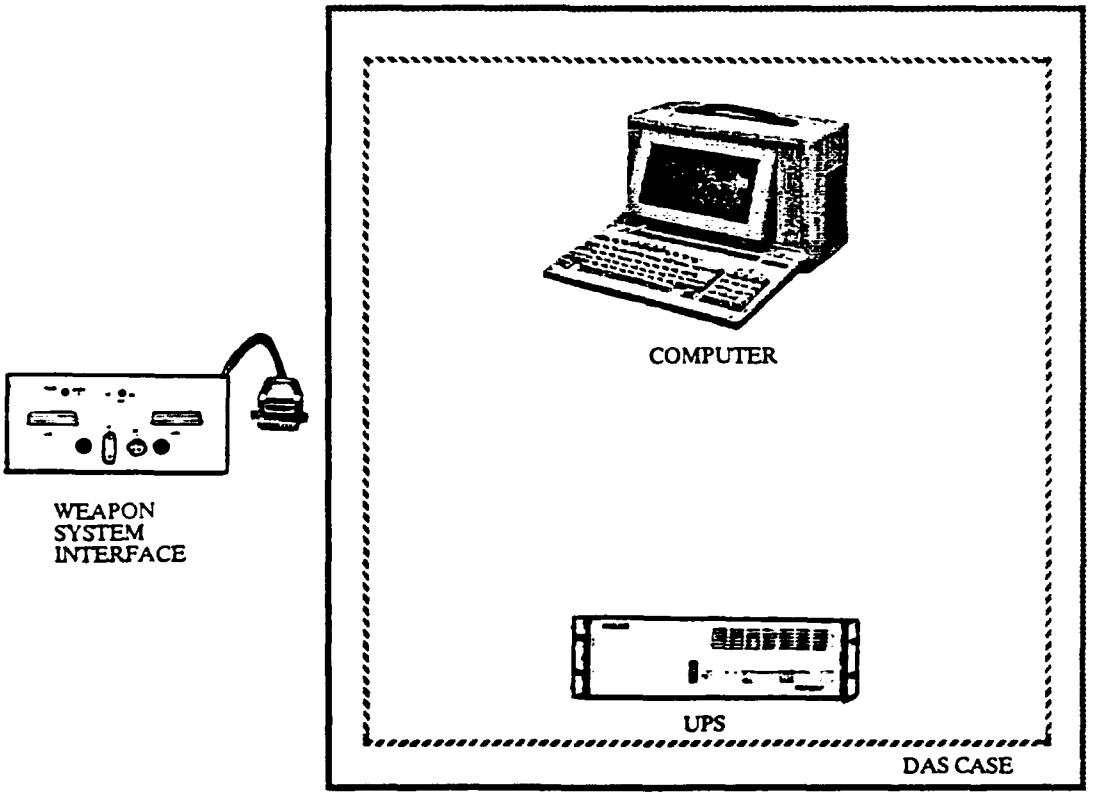


Figure 6. Data Acquisition Station

Position-Location Station (PLS). The PLS (see Figure 7) is used for two key purposes. First, it is used to register (ground locate) the weapon, the pop-up helicopter stands, flying target launch positions, and the RTS stations (RCS, DAS, and PLS). Second, it is used to track and range flyable targets during a scenario. The PLS has the ability to detect, acquire, and track flyable targets automatically. However, it can also be operated manually using the trackball control console.

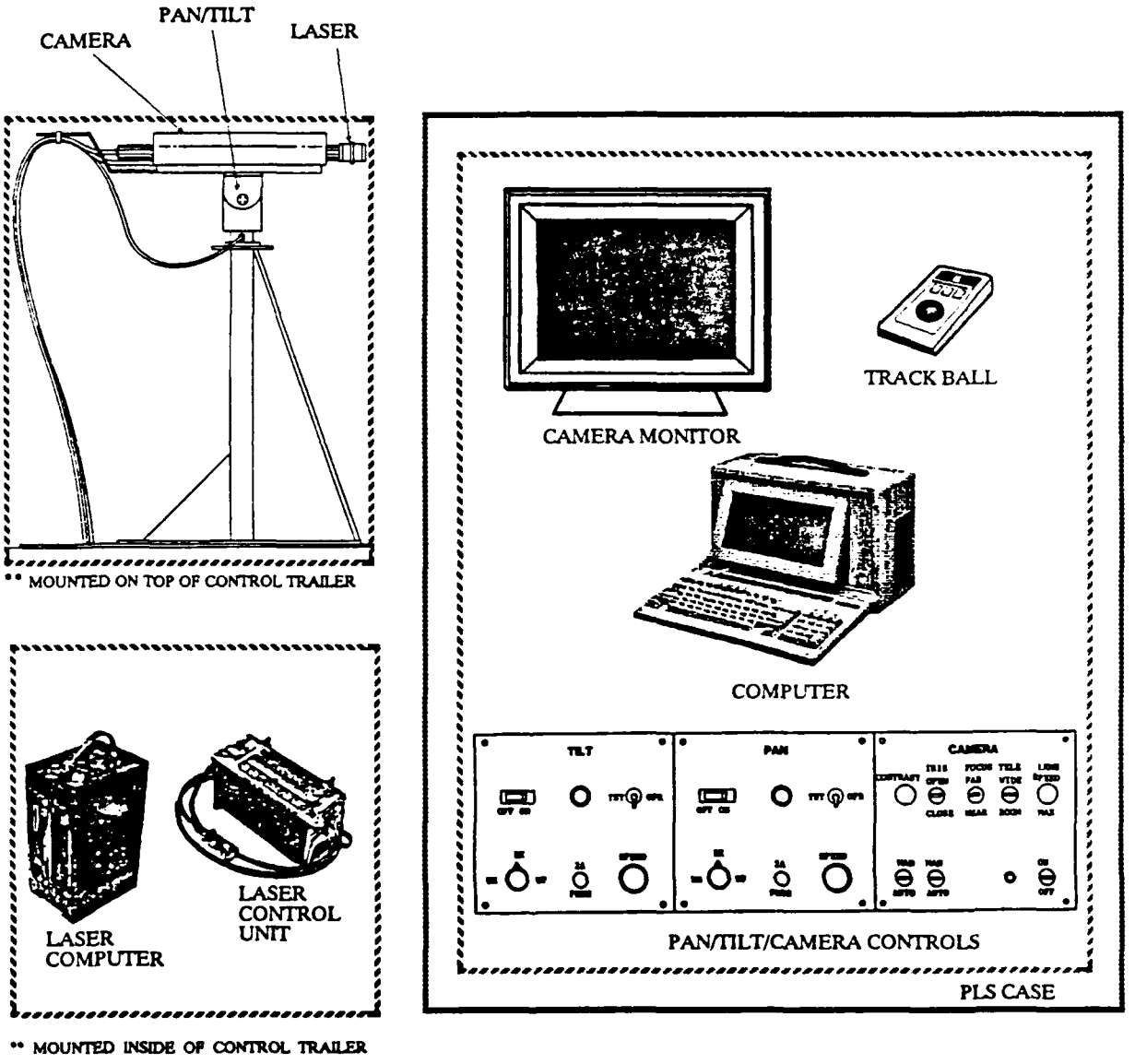


Figure 7. Position-Location Station

After being unpacked from the RTS Trailer, most of the control and monitoring equipment will be emplaced inside the trailer. However, the PLS laser, camera, and pan-tilt assembly will be mounted on top of the trailer. The PLS must be operated from an elevated position. The PLS consists of a station computer, a laser unit, laser retro-reflectors, a long range wide-angle camera, a camera display screen, a special purpose laser computer, a pan-tilt mount control and data assembly, manual trackball and PLS control consoles, and a communications interface which connects the PLS to the RCS (via computer ports).

Laser Ballistics Simulator (LBS). RTS includes additional capabilities for use with Vulcan and PIVADS weapons during engagement simulation exercises. One capability is the measurement and feedback of number of bursts, rounds-on-target, mean miss distance and direction, and central hit point. Another is through-the-reticle flyout of tracer rounds in a high-fidelity ballistic simulation at the weapon. All these capabilities are provided by the SAAB BT-53 laser simulator, which is interfaced to the DAS.

The LBS consists of a laser unit, computer, tracer unit, elevation sensor unit, trigger device unit, feedback control unit, and power supply. All of these devices are mounted on the 20mm gun system, and provide a very powerful free play capability, while also extending the gun system scoring capabilities of the RTS. The Laser Ballistics Simulator is depicted in Figure 8.

Procedures Overview

The three major areas of operation are as follows:

- System Preparations -- This involves the startup of the system, the test and calibration of system components to verify operability, the entering of crew identification information, and the selection of scenarios to run.

- Realtime Operations -- This involves the actual execution of scenarios, the collection and upload of data from the weapons and soldiers, and the scoring of performance for immediate feedback to the troops on a trial-by-trial basis.

- Post-Processing Operations -- This involves the aggregation of performance data after the execution of one or more scenarios, or an entire training or test application. Summary feedback is generated and reports on performance are output to the printer. System shutdown is the last procedure to be performed.

Table 1 lists the primary procedures according to the order in which they are normally performed. Included is a reference to the section in this manual where the procedures are described in detail.

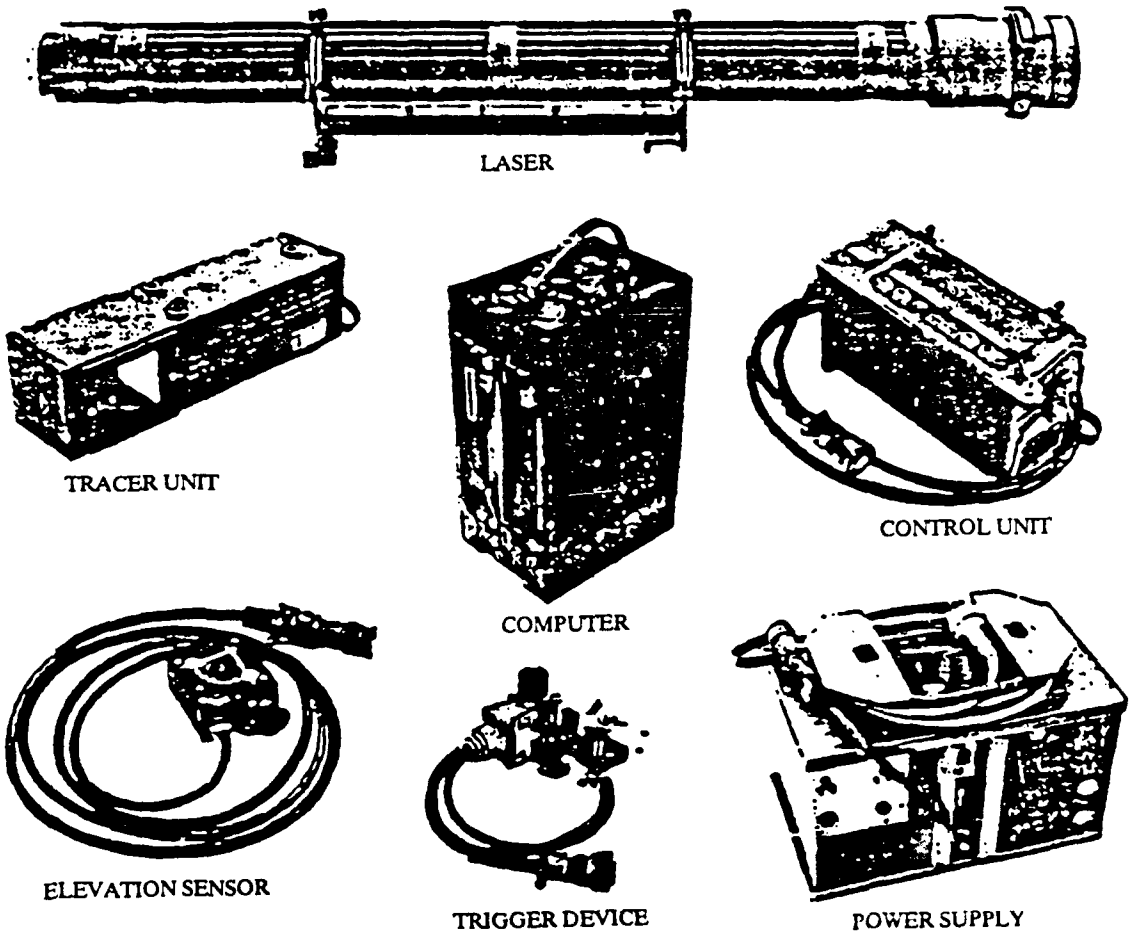


Figure 8. Laser Ballistics Simulator

Table 1

List of Procedures in RTS Operations

PROCEDURE	PAGES
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RTSETUP

RTSETUP must be performed prior to executing a system application to identify the weapon system to be used, the location of stations and PHTS, the scenarios to be run, and the training or test conditions. These data are input into the RCS computer. This is done only once for a given application. The data are changed when there is a change in weapon type, the user wishes to add scenarios to the scenario library, or RTS components are to be relocated. This section describes the procedures for specifying the constants, scenarios, weapon, and target descriptions.

Unpack the RCS station computer (computer, monitor, and keyboard) and printer (refer to Unpacking System Equipment in the next chapter). Attach the computer and printer and plug them into a 115 volt power source (refer to vendor manuals on the computer and printer for more information). The RCS will automatically boot itself, resulting in the display of the main menu. Press the <ESC> key. A message will ask if RTS is to be terminated, answering "Yes" will automatically return the RCS computer to the operating system.

To enter the RTSETUP program, type "RTSETUP" at the RCS keyboard after the operating system prompt (-) and press <ENTER>. This will result in the display of the RTSETUP main menu as shown in Figure 9. Select the desired utility by typing the letter which corresponds to the option.

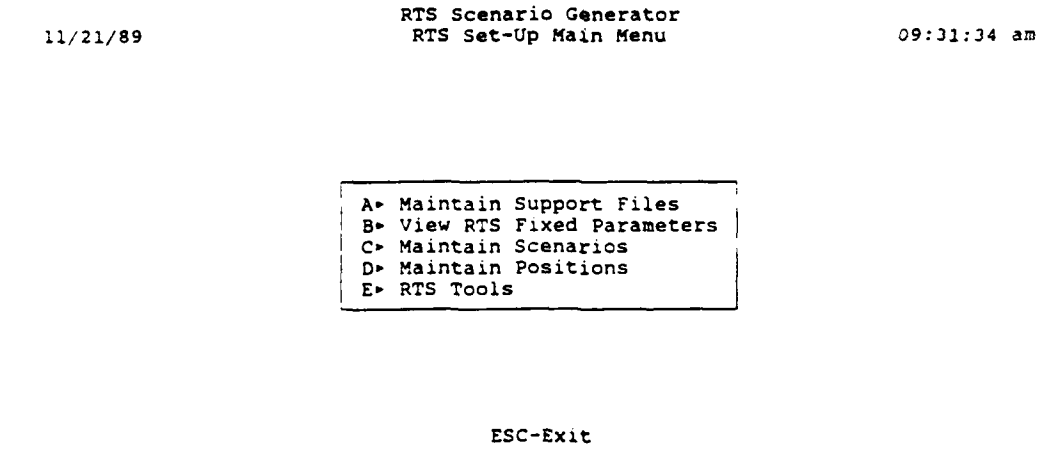


Figure 9. RTSETUP Main Menu

Maintain Support Files

This is the first option in the main menu (option "A"). Use this option to add, delete, edit, and view any selection listed on the menu (see Figure 10).

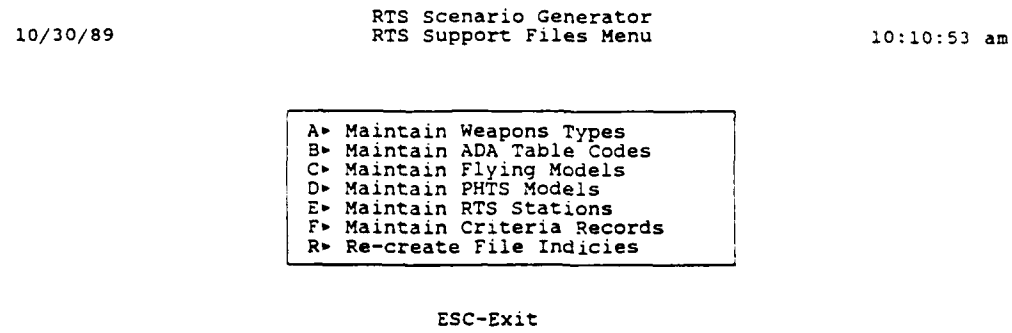


Figure 10. Maintain Support Files Menu

Select "Maintain Weapons Types" (option "A") from the Support Files Menu to specify the weapon(s) to be used (see Figure 11). Press the <F2> key to add weapons. To delete a weapon press <F3> and to recall an item press <F4>. The weapon number is displayed on the left of the screen. The current weapon type being edited will be displayed on the right. Scrolling through the numbers on the left (using the up or down arrow keys) will result in a change in the descriptions on the right to correspond with the weapon number highlighted. To edit a selection, press <ESC> when the highlighter is on the appropriate weapon code number. Scroll through the options on the right and make any desired changes. The available codes for Projectile Type are shown at the bottom left of the display (see Figure 11). (Note: Classified data are not to be entered into this system.)

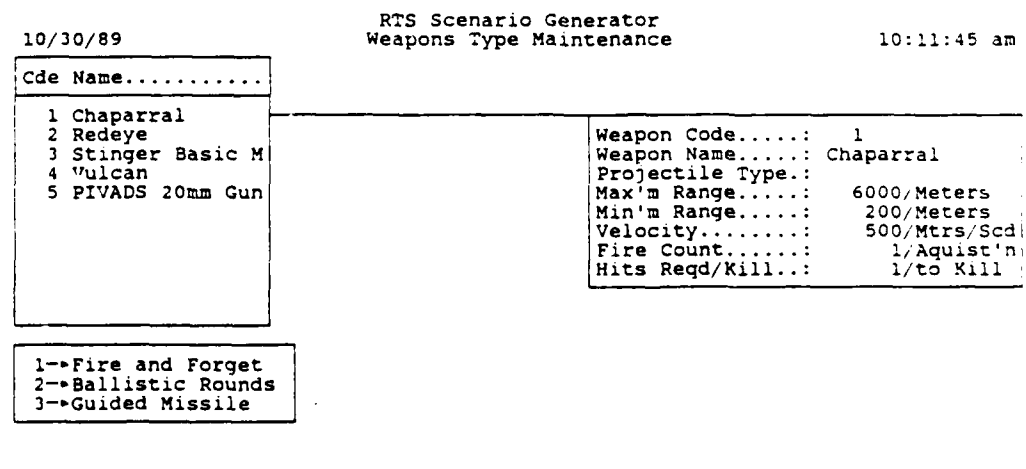


Figure 11. Maintain Weapons Types Menu

The "Maintain ADA Table Codes" (option "B") of the Support Files Menu is for identifying applicable range tables (see Figure 12). These tables represent the annual qualification tests for Stinger, Chaparral, and Vulcan or PIVADS weapon crews. This menu will not be needed unless the government changes the range tables or descriptions.

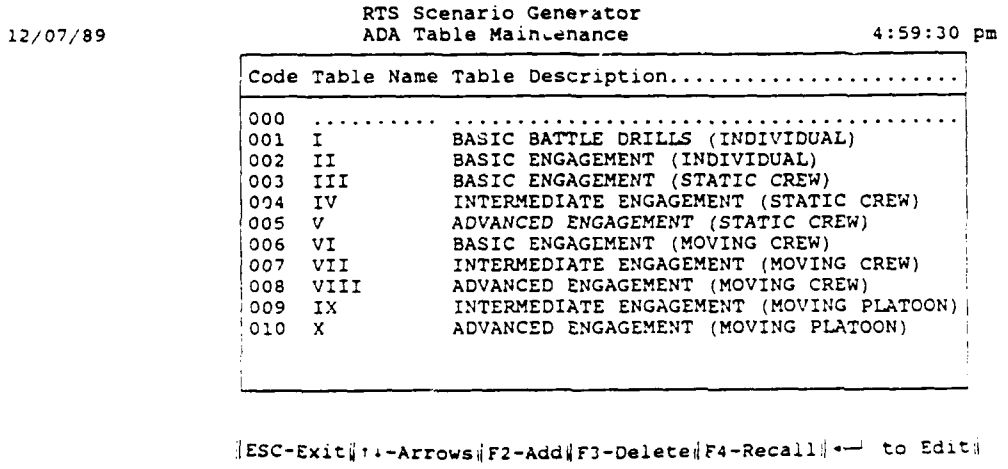


Figure 12. Maintain ADA Table Codes Menu

"Maintain Flying Models" (option "C") of the Support Files Menu is used to list the flying target model types (see Figure 13). The code numbers along with aircraft model names are listed on the left. The information corresponding to the selection on the left are listed on the right. All information can be edited. Available Friend/Foe and Aircraft Type codes are displayed on the bottom left of the screen.

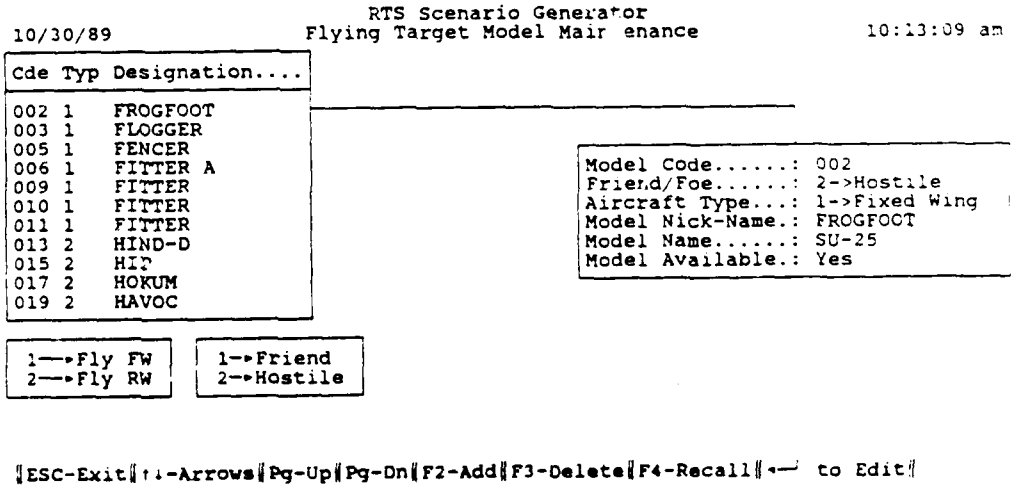


Figure 13. Maintain Flying Models Menu

The "Maintain PHTS Models" (option "D") of the Support Files Menu is used to list the pop-up helicopter target system model types (see Figure 14). Like the previous option, available Friend/Foe and Aircraft Type codes are displayed on the bottom left of the screen. Information about the aircraft are presented on the right.

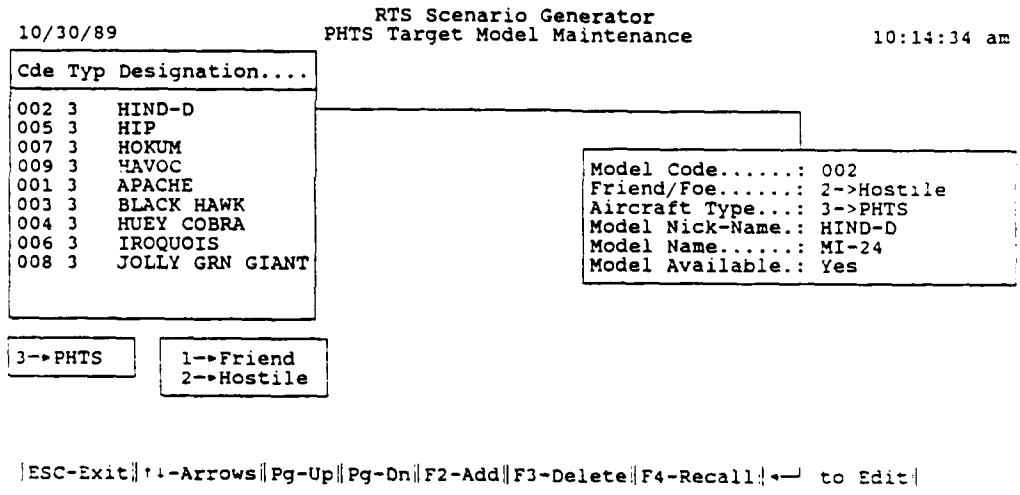


Figure 14. Maintain PHTS Models Menu

"Maintain RTS Stations" (option "E") of the Support Files Menu is used to identify RTS stations by numeric codes and descriptions (see Figure 15). The RTS components are listed on the left. The limits on these stations are listed on the right. The only restriction to the station limits is the number of components available. For example, if there are only 6 PTS target systems defined, only six numbers can be used as codes (usually 1 through 6). These codes will identify which PTS will appear during scenario development and execution.

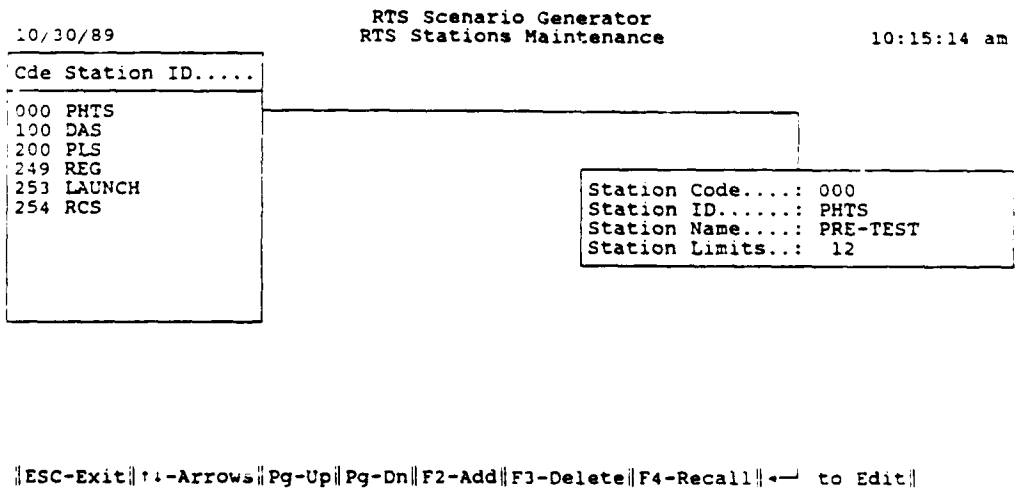


Figure 15. Maintain RTS Stations Menu

The "Maintain Criteria Records" (option "F") of the Support Files Menu is not directly accessible. This option is used to view the current performance standards which are defined according to US Army Air Defense doctrine. These criteria are the accepted standards and are not subject to change without a change in doctrine. In the event that they did change, the corrections would have to be made using the DBASE software utility, which is outside the scope of this manual.

The "Recreate File Indices" (option "R") of the Support Files Menu is used to reindex the system files after changes have been made. For example, if some scenarios were added or changed, this option would have to be invoked to ensure all supporting files had the updated information. Use this option at the end of each editing session to ensure all changes made are consistent across all support files. Invoking this option will automatically execute the reindex process, returning to the main menu when complete. Thus, no further interaction is required.

View RTS Fixed Parameters

This is the second option in the RTSETUP Main Menu (option "B"). Selecting this option will result in a display of the fixed parameters that are employed in developing scenarios (see Figure 16). Select an option on the left of the display by pressing <ENTER> when the desired choice is highlighted. This will result in the display of possible option codes on the right of the display. For example, if "PTS Orientations" is selected, each aspect angle (orientation) available for PTS targets will be displayed on the right (see Figure 16). The appropriate parameters will be input when developing scenarios (for example, a helicopter scenario with 0 aspect, front view). Fixed parameters are not likely to be changed.

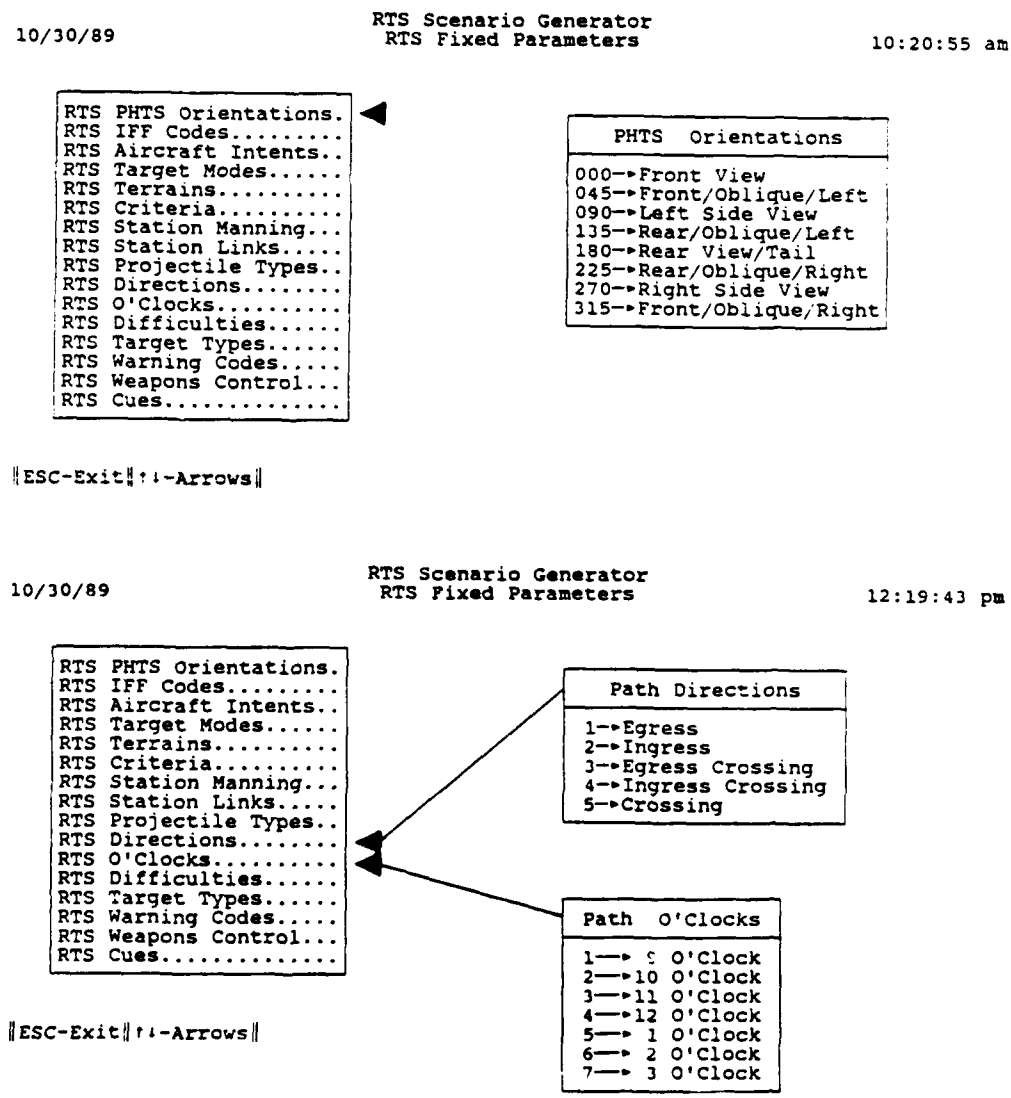


Figure 16. View RTS Fixed Parameters Menu

Maintain Scenarios

This is the third option in the RTSETUP Main Menu (option "C"). This selection enables the user to develop scenarios and is the option most commonly used. Any description item can be edited, added to, or deleted. To edit a particular scenario, position the highlighter over the Scenario # row using the arrow keys. Press <ENTER> when the scenario number to be edited appears (see Figure 17). To scroll forward or backward (i.e., select a higher or lower scenario number), place the highlighter over the Scenario # row and page up or down using the up or down <PG> keys, respectively. To add a scenario, press the <F2> key and type in the new scenario number.

Once a scenario has been selected, the scenario descriptions to be edited can be identified by moving the highlighter with the arrow keys. Select a highlighted descriptor by pressing the <ENTER> key. The scenario descriptions are listed on the left of the display, with possible options listed on the right (see Figure 17). Relevant descriptors must then be given desired parameters (see preceding Fixed Parameters section).

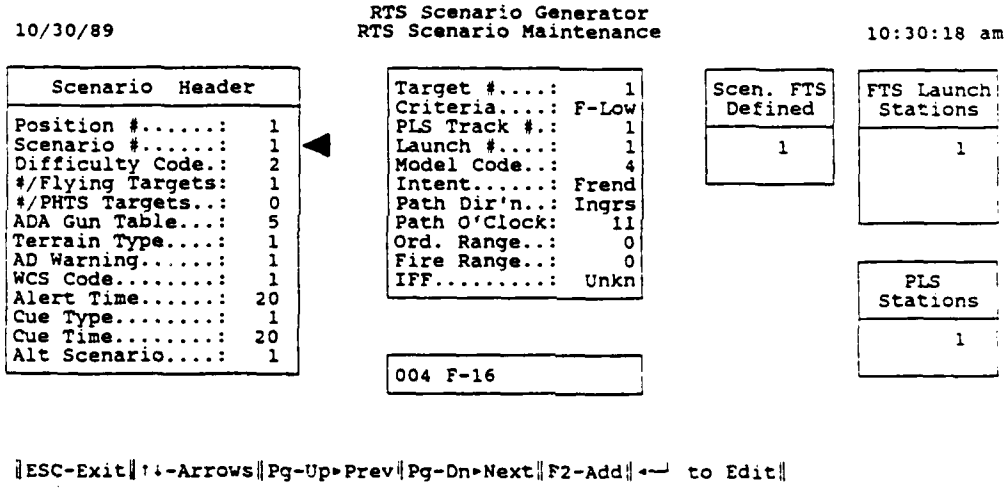


Figure 17. Maintain Scenarios Menu -- FTS options

Entering of old or new scenarios, editing them, and giving parameters to them is a completely prompted and interactive process. There may be several areas within each descriptor that must be edited. Edit each item in sequence through the last area; the highlighter will then automatically return to the descriptors (left) side of the screen. A scenario may have more than one target. For example, if three PHTS are scripted, three sets of parameters will be entered. The PHTS portion of the scenario is entered by selecting "#/PHTS Targets". After the first target is edited, the system will prompt for the next one. Enter the next PHTS target stand number (such as stand 3 or 8), or 0 if there are no more, and continue (see Figure 18).

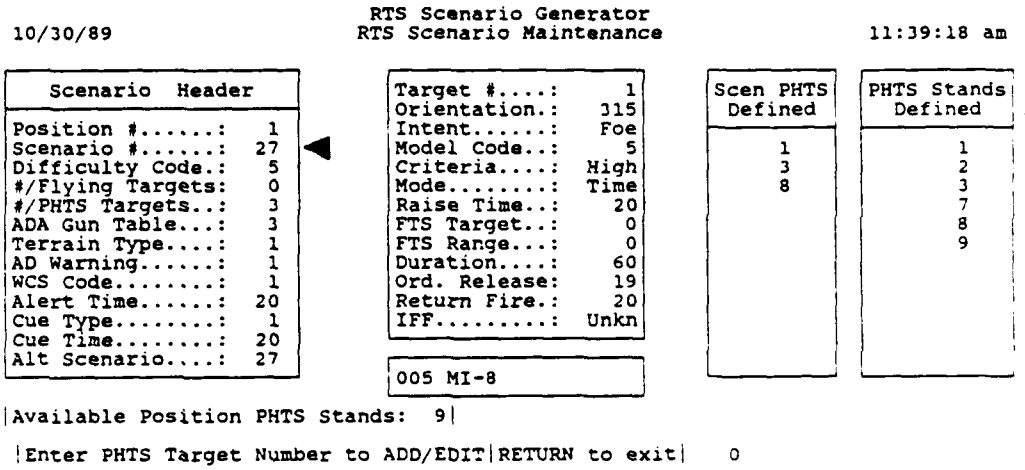


Figure 18. Maintain Scenarios Menu -- PHTS options

Scenarios of equal difficulty to the one being edited can be designated as alternates using "Alt Scenario" (see Figure 19). When scenario presentations begin, there may be several scenarios to choose from within a given difficulty level. This may be useful if the instructor-evaluator wishes to present several alternate training scenarios of like difficulty, or to avoid repeating a scenario in the event of a previous trial abort.

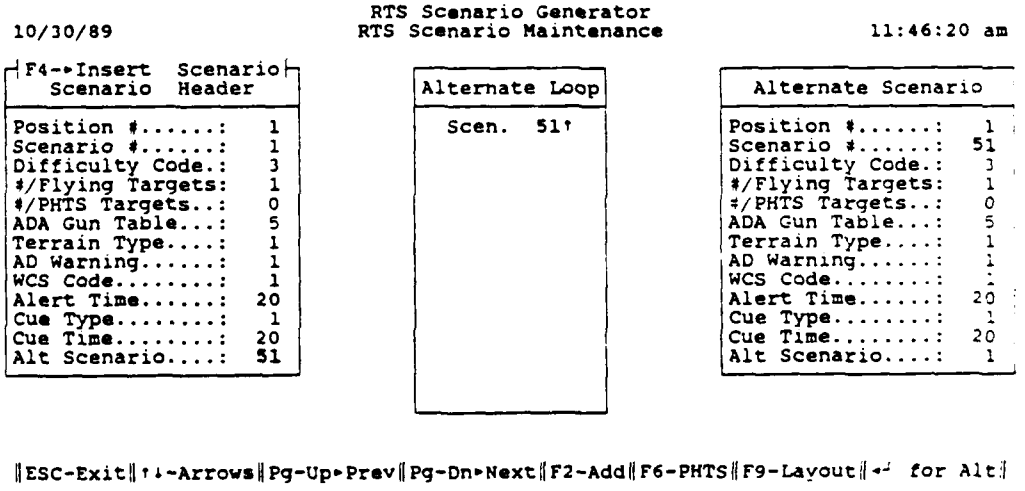


Figure 19. Maintain Scenarios Menu -- alternative scenario option

Maintain Positions

This is the fourth option of the RTSETUP Main Menu (option "D"). It is used to enter and edit the positions of RTS components (see Figure 20). The position codes are listed on the right of the screen, associated parameters are listed in the middle, and option codes are listed on the left. This menu serves two purposes. It enables the development of a preliminary range layout scheme and the printing of an associated hardcopy reference of that layout. The scheme will then be fine-tuned when the system is actually emplaced and registered for a final layout and hardcopy reference. The preliminary range layout is used to define PTS locations relative to the DAS or weapon (coordinates 0,0). Other component locations are determined during deployment.

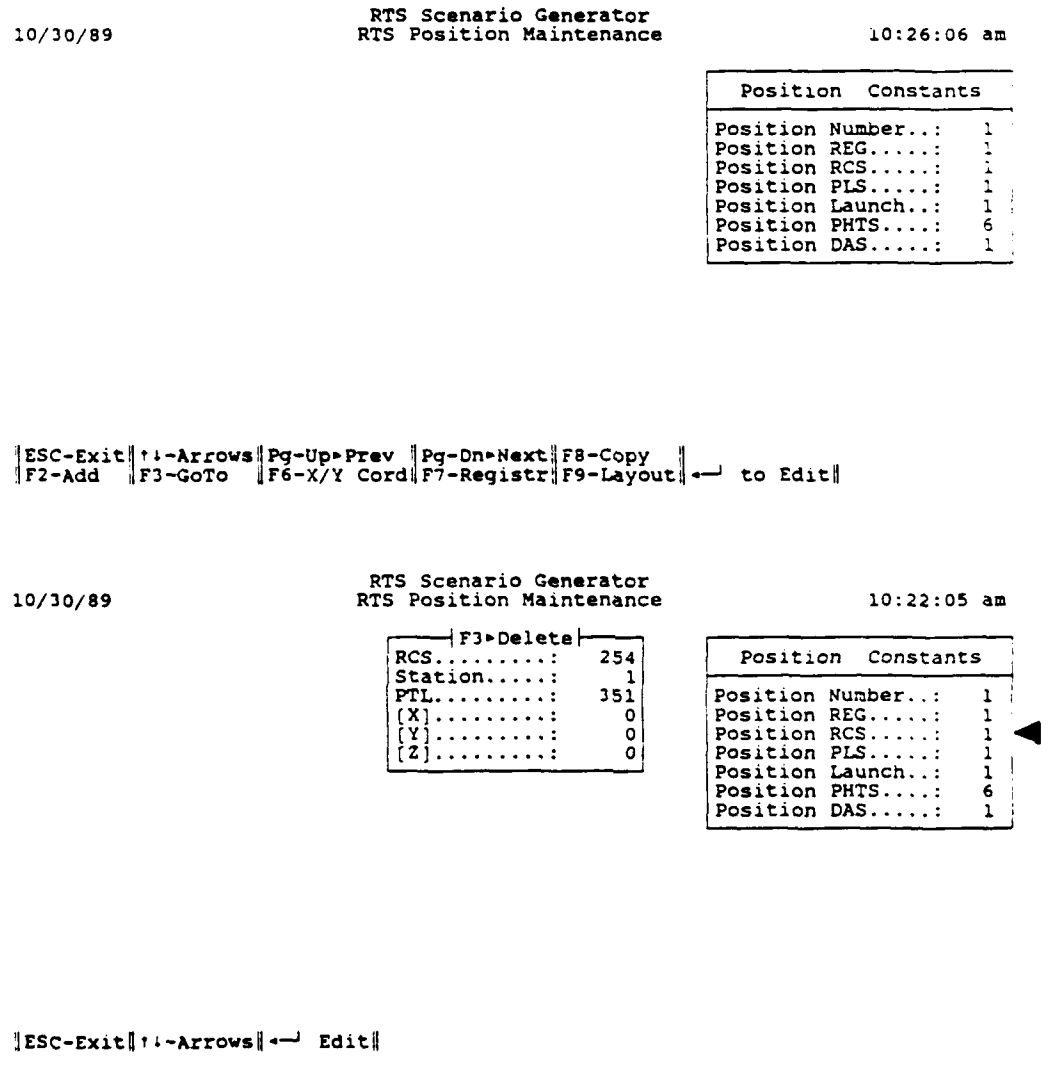


Figure 20. Maintain Positions Menu

When the system components (including the PTS) have been emplaced, they are position-located in coordinates (i.e., registered using the PLS laser). These data are entered over the preliminary data and become RTSETUP parameters. Once the proper coordinates are entered, these remain constant unless the components are moved and re-registered. Typically, the position parameters are entered only once, unless the user wishes to change the configuration or move the RTS to a new location. The most common exception is when the weapon system employed changes. The weapon code number must be changed to reflect the current weapon so that the appropriate databases are activated. This is done using the DAS Positions option (see Figure 21).

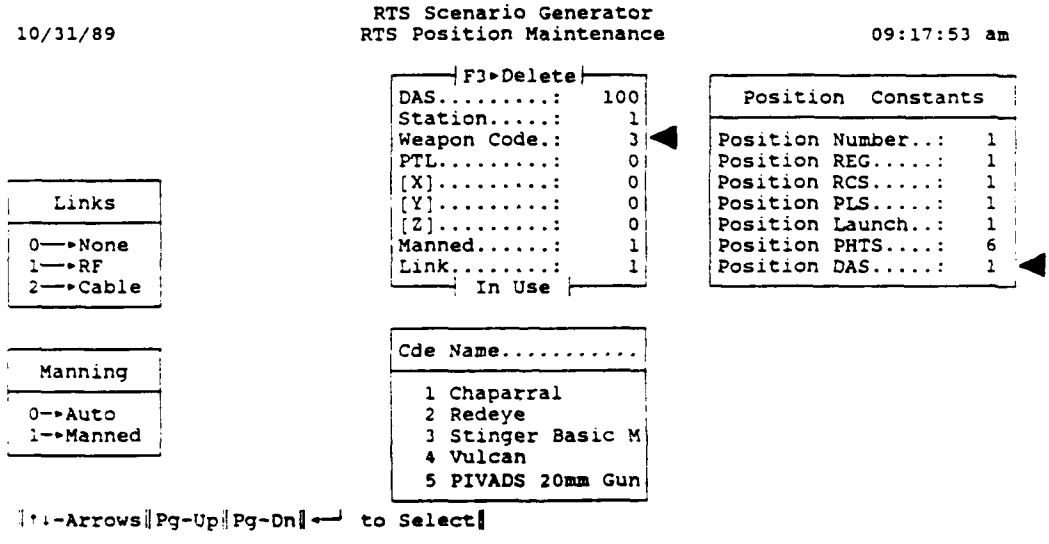


Figure 21. Maintain Positions Menu -- DAS option

To plan a layout, first assign the DAS a position and a primary target line (PTL); all other component locations are based on that position (i.e., the weapon location). Typically, the DAS X and Y coordinates are 0,0 respectively, and the PTL is 180 degrees. The PLS and RCS can also be located at 0,0 coordinates to make things simpler. Then select the other components (e.g., PTS), assign a code number, assign a range (actual, not scaled) and assign a clock azimuth. Press the <F7> and then the <F10> keys to have the coordinates computed for that component.

To view the layout of PTS components in range space coordinates press the <F9> key while in the "Maintain Positions" menu. This enables the user to view the current range layout of PTS in a two-dimensional graphic representation, showing their relative positions on the ground (see Figure 22). Pressing the <Print Screen> key will generate a hardcopy of the layout. In the example below, there are six targets (1,2,3,7,8,9); the weapon position and control areas are coincident with the DAS.

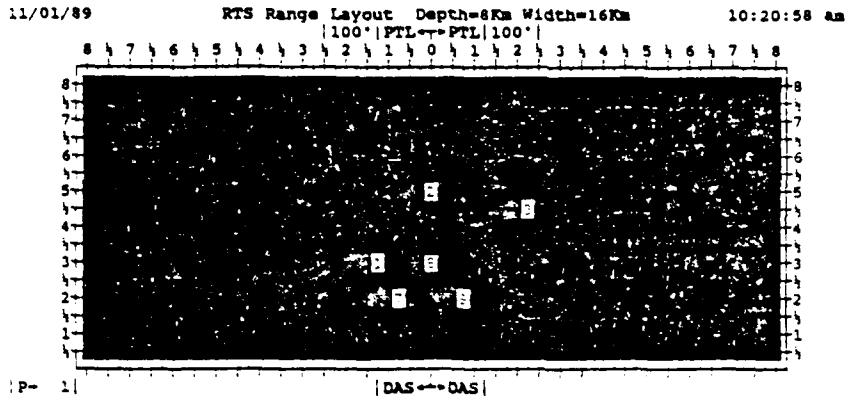


Figure 22. PHTS range layout diagram

RTS Tools

This is the last option in the RTSETUP main menu (option "E"). This option enables the user to build sets of scenarios and print scenario listings. Selecting this option will result in the display of the RTS Tools Menu (see Figure 23). Option "1" is employed to create a master database file of the existing scenarios previously developed. Use this option whenever scenarios have been added or changed, to update the master file. Option "2" enables the printing of a formatted listing of all existing scenarios along with their parameters. This listing provides scenario specifications that can be used by the system operator to ensure the right scenarios are selected and administered.

Options "3" and "6" can be used to build sets of scenarios to be executed during a given test. Two different sets can be developed. For example, sets of equally difficult scenarios may be required so that experimental groups or trainees do not receive exactly the same scenarios. Or one may wish to compare sets of scenarios, and so forth. The scenario sets can be printed by selecting Options "5" and "8" respectively. This will generate a formatted listing of all scenarios in the set. The system operator may use this printout as a reference when executing a set of scenarios. To delete an old set and create a new one, use the "Zap" options. Each of the functions in the "Tools" menu are completely interactive, requiring no further elaboration here.

```
                    Scenario Set Builder
11/21/89                RTS TOOLS                       09:32:13

  SCENLOG.DBF must be updated when new scenarios are created.

        1       Create SCENLOG.DBF
        2       Print Master Listing of all Scenarios
        3       Build Set A
        4       Zap Set A
        5       Print Set A Worklog
        6       Build Set B
        7       Zap Set B
        8       Print Set B Worklog
        Q       Exit to RTSETUP

   Select Option:
```

Figure 23. RTS Tools Menu

System Preparation and Installation

This chapter describes the tasks that need to be performed to prepare the system for operations. This is followed by instructions for configuring the RTS to work with a specific weapon for a particular training or test application. Included is the unpacking, emplacement, and registration of the Position-Location Station (PLS), Range Control Station (RCS), Data Acquisition Station (DAS), Flying Target System (FTS) launch point(s), and Pop-up Target Systems (PTS).

Selecting a Site

Figure 24 depicts a typical RTS site complete with station locations, flight paths, and helicopter stand positions (this site is similar to those used during RTS validation). The range area can be anywhere from 1 to 4 kilometers (km) square, depending on the terrain in which it is to be employed and user requirements. For example, a larger range space would be recommended for flat (desert or tundra) terrain, and a smaller range space for dense (forest or jungle) terrain. As shown in Figure 24, 1/5 scale PTS target presentations generally take place within one km of the weapon. FTS targets can be launched from anywhere on the range, and flown according to any desired pattern.

Providing sufficient intervisibility among critical components while allowing for range monitoring and control are major considerations for site selection. The site should afford the emplacement of a weapon position and an assignable search sector, in which terrain and foliage do not visually obscure flying target flight paths or pop-up helicopter presentations. The position-location system should be able to maintain line-of-sight with the flying target launch area. Pop-up helicopter targets should be out of sight when in the down position (i.e., should emerge from some terrain mask when presented). Target background terrain should not vary randomly between mountain and sky. A range allowing the experimental control of target background contrast may be considered.

Position-location decisions meeting terrain and component intervisibility requirements should be made before emplacing the system. A terrain map of the range area may help during site selection and choosing target and weapon locations. RTS components can be positioned accordingly when registration is performed. RTS coordinates can be plotted on a terrain map for additional reference. RTS coordinates can coincide with map coordinates if desired.

Choose a site free of electrical telephone lines or other lofty obstructions as they are a hazard to maneuvering aircraft. The aircraft are usually flown at altitudes less than 500 feet. The RTS requires certain radio frequencies for the control of aircraft, data link communications, and range command, control and communications. The following frequencies should be authorized for the site selected (i.e., the site should be free of interference on these frequencies).

Portable Radio Net Frequency: 145.150 MHz (MegaHertz)
Aircraft Control Frequency: 72.550 MHz
Target Data Link Frequency: 72.020 MHz

If the application requires the live fire of gun systems, there are a few additional concerns for site selection. Range communications and control, range servicing, and engineering support requirements are major considerations. Authorized live fire range selection, range scheduling, and range clearance (frequencies, airspace, etc.) should be planned well in advance. Further, protective berms (sand dunes, etc.) are advised to enable the pop-up target systems to be used repeatedly, without suffering extensive damage.

Once a site has been selected, the range layout can commence. This begins with the planning of component locations, control centers, communications interfaces, and engineering support. Selection of flying target launch and recovery points and pilot control locations and practice in the execution of flying target flight patterns should also begin.

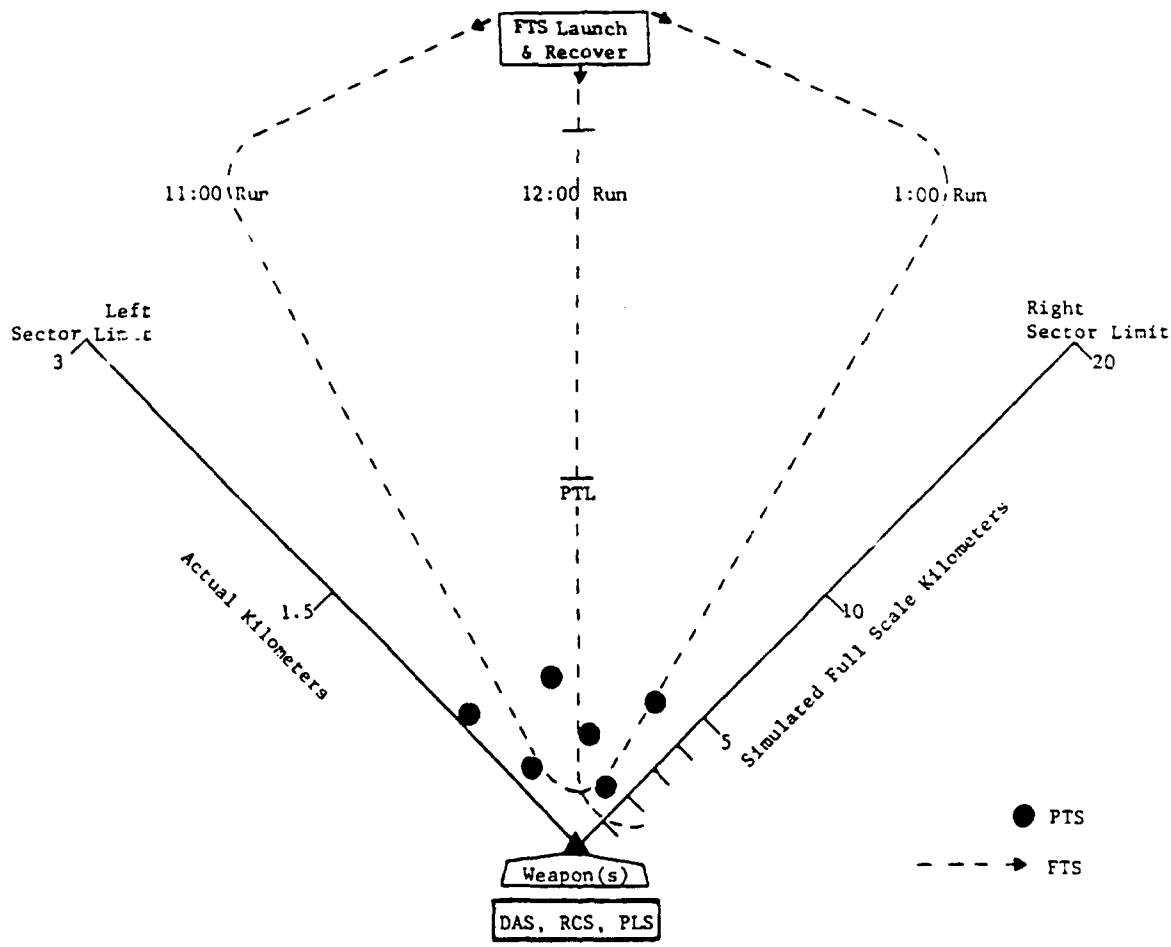


Figure 24. RTS range layout

Unpacking the RTS

With the exception of the FTS and the PTS, all RTS items come packaged in the RTS Trailer. The following checklists represent major items that will need to be unpacked. There is currently no prescribed order in which the RTS Trailer should be unpacked. It is recommended, however, that the RCS, DAS, and PLS be completely unpacked and verified against the checklists before starting emplacement operations.

- Range Control Station (RCS) checklist

Printer & cable	Modem & cable
UPS & cable	Power strip
9 volt AC adaptor	RF power amplifier
Antenna, tripod, & coaxial cable	Generator & extension cord
12 volt battery & battery charger	Computer, monitor, & keyboard
Communications link (cable) to PLS	Communications link (cable) to DAS

- Data Acquisition Station (DAS) checklist

UPS & cable	Power strip
Generator & extension cord	Weapon system interface & cables
Computer, monitor, & keyboard	
Stinger, Chaparral, & Vulcan or PIVADS interface cables	

- Position-Location Station (PLS) checklist

Camera & cable	Pan-Tilt assembly & cable
Computer, monitor, & keyboard	BT-53 control unit & cable
BT-53 computer	BT-53 power supply & cable
BT-53 laser & cable	Camera display monitor & cable
Pan-Tilt-Camera console & cables	Trackball console & cable
BT-53 to PLS communications link (cable)	

- Laser Ballistics Simulator (LBS) checklist

BT-53 laser & cable	BT-53 control unit & cable
BT-53 computer	BT-53 power supply & cable
BT-53 trigger assembly & cable	BT-53 elevation sensor & cable
BT-53 tracer unit & cable	BT-53 simulator stand

- Flying Target System (FTS) checklist

  FTS transport trailer
  FTS target launcher
  5 portable radios & battery chargers
  3 RF transmitters, 3 RF receivers, & batteries
  Target systems -- A7, A10, F16, MiG27, Su17, Su25 (3 each; 1/5 scale)

- Pop-up Target Systems (PTS) checklist

  6 target systems (trailer or tripod version)
  6 antennas, tripods, & coaxial cables
  Target skins -- AH1, AH64, CH3, UH1, UH60, Mi8, Mi24, Mi28, Ka??
  (3 each; 1/5 scale) (Ka?? is known as the Hokum)

- RTS trailer & facilities

  Pan-tilt support assembly
  Trailer-mounted ladder
  3 ruggedized RTS station equipment boxes
  Mounting bracket installed on roof for pan-tilt

Emplacing the Equipment

The recommended order of emplacement is as follows:

- The PLS laser and camera are mounted on the pan-tilt assembly which resides atop the RTS Trailer. The trailer is equipped with pre-installed mounting brackets. The trailer should be positioned so the camera and laser have an unobstructed field of view to aerial targets, target launch points, and weapon system positions. The PLS should be located close, if not coincident, to the exercise control area (i.e., RCS).

- For engagement simulation, the RCS should be centrally located such that all major components can be visually monitored including the weapon sites, DAS, and PLS. For live fire, the RCS should be positioned coincident with the control tower.

- The DAS can be emplaced anywhere from 10 to 100 feet from the weapon system to which it is hooked. However, it is advisable that the DAS operator have visual contact with the exercising troops. The DAS can also be collocated with the RCS if desired.

- Ideally, the launch point for flying targets should be down range along the weapon PTL. Remote launch enables pilots to begin flight paths quickly, to repeat flight paths consistently, and to present aircraft at visual detection threshold range. However, the launch point can be located anywhere that

requirements dictate. For example, for LFX purposes, the launch and recovery position would have to be behind the firing line. Usually three pilots are required: one at the launch point, and two mobile pilots. Mobile pilots should be positioned strategically, to enable the execution of all scripted flight paths.

- Pop-up helicopter target systems should be emplaced down range consistent with the scenario (range) specifications (e.g., o'clock azimuth to the weapon, distance from the weapon, etc.).

Connecting the Components

The cabling connections depicted in Figure 25 are implemented anytime the system is packed up and moved to another location.

Computer component interconnections. All computer components are directly cabled together and to peripheral devices (including the weapons). Refer to vendor manuals for more information. Computers and other peripherals (printer, camera, battery charger, AC adaptor, etc.) plug into one of two power strips as shown in Figure 25. Connect the RCS modem and power amplifier (see figure).

Connecting the PLS cables. Plug in the three BT-53 cables and screw on their cable collars: laser, power supply, and control unit (see Figure 26). Ensure that the cables are not twisted or strained and that there is sufficient slack to allow the PLS to rotate freely to the limits of the orientation circle. Connect the BT-53 control unit to the BT-53 computer, the BT-53 computer to the PLS computer, and the BT-53 trigger assembly to the pan-tilt console (see Figure 25). Refer to BT-53 documentation for more information.

Connecting target components. Targets are connected to the RCS via radio frequency (RF) data links. Place the small light-weight antenna masts away from the computers and power plants at each PTS station (and at the RCS), plug in the antenna cables, and screw on the cable collars. When the antenna placement and connection are complete, the target systems can be energized. Disconnect and secure the target antennas when the targets are not in use.

Connecting the power. Connect the 115 Volt power generators to the DAS UPS and to the RCS-PLS UPS. The DAS generator also connects to the WSI and the RCS-PLS generator connects to the BT-53 power supply (see Figure 25). The UPS are connected to power strips to which computer peripherals are connected.

Connecting the Laser Ballistics Simulator. This procedure is similar to the connecting of the PLS. Both use the BT-53 laser, computer, and control unit. Refer to Figure 27 (and the BT-53 documentation, as required).

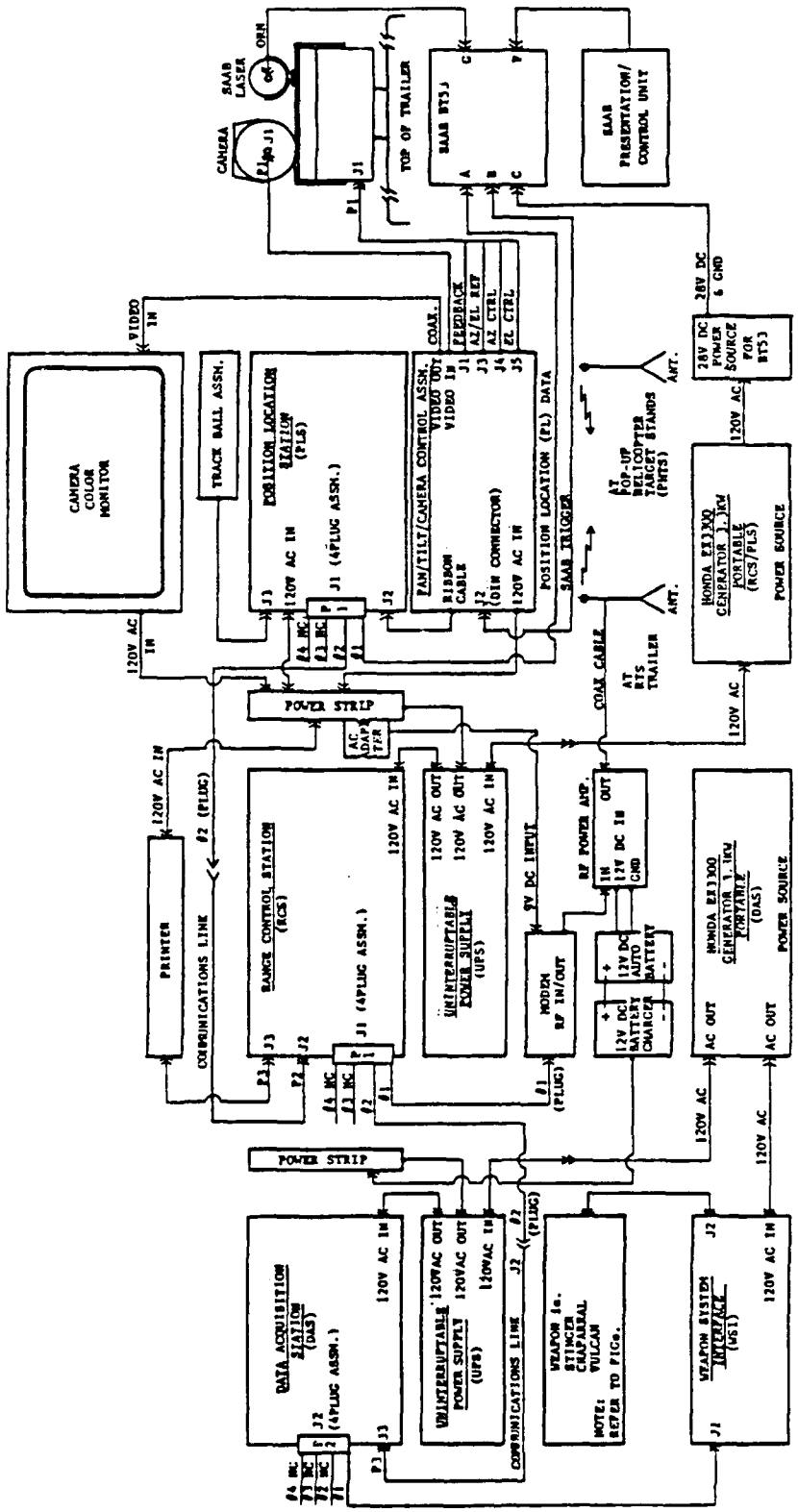


Figure 25. RTS system cabling diagram

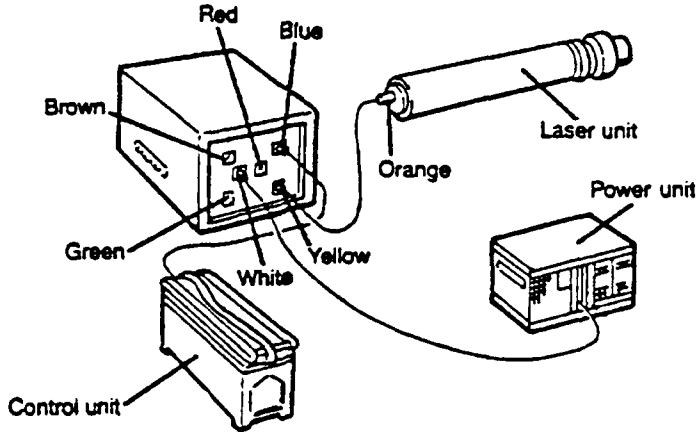


Figure 26. Position-Location Station BT-53 cabling diagram

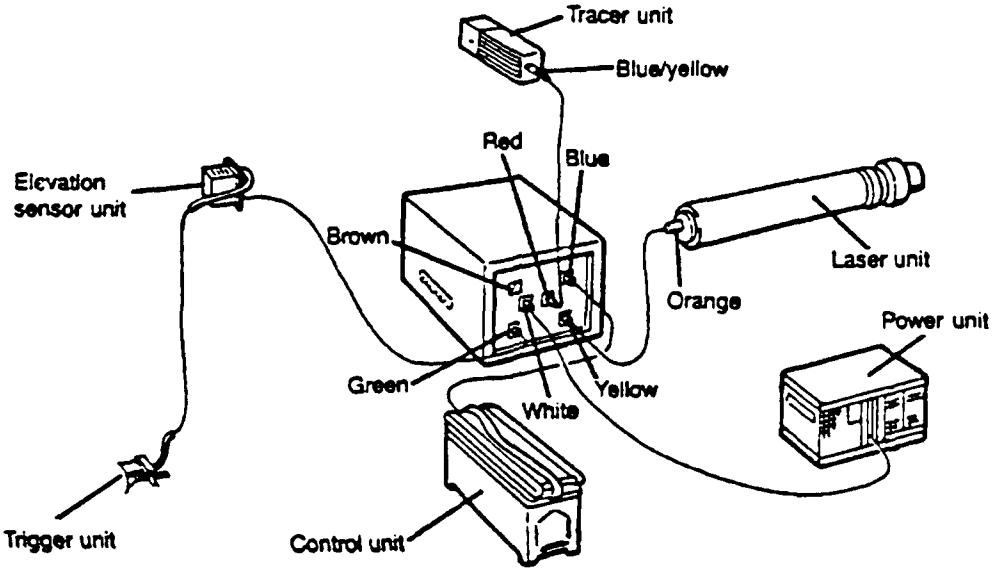


Figure 27. Laser Ballistics Simulator cabling diagram

System Startup and Shutdown

The procedures below are followed in sequence to energize the system every day. To shut down the system, perform the procedures in the reverse order.

Energize the system generators. First ensure that the generator has sufficient oil and gasoline and check filters (refer to generator operator's manual). Insert the ignition key and turn switch to "On" (refer to Figure 28). After about ten seconds, switch to "Start"; release the key when the generator starts. The generator will need to run for a minute or so to warm up. Once it is running smoothly (evidenced by a change in noise level), turn on the output circuit breaker. This procedure also applies to energizing the PTS generators (refer to PTS operations described at the end of this chapter for more information.)

Activate system stations. Connect the positive lead of the RF amplifier to the positive pole of a 12 Volt battery for communications with the PTS. Turn on the two UPS which provide power to the RCS-PLS and DAS (only one switch, at front and center). Turn on each station computer (switch is at left, rear). Verify that the RCS and DAS station computers display their respective main menus after a minute or so.

Activate the PLS. "Test-Operate" toggle switches on the PLS "Tilt" and "Pan" Consoles (refer to Figure 29; Figure 58 also depicts the Pan-Tilt-Camera Console) should be in "Test" position (i.e., they are switched to this position to de-energize the system). Energize the "Tilt" and "Pan" Consoles (move slide switches from the "Off" to the "On" position). Energize the BT-53 control unit (refer to Figure 29) by simultaneously pressing the following keys: "<-" and "-" (the BT-53 box is shut off by simultaneously pressing these keys: "->" and "+"). Place the BT-53 control unit in "Measure" mode by pressing the "+" key. On the PLS Control Console, move "Tilt" and "Pan" toggle switches from the "Test" position to the "Operate" position. Verify that the PLS display shows the main menu and the camera display shows the current orientation of the laser. Perform BT-53 calibration check. (Refer to vendor documentation on BT-53 for more information on operations and calibration.)

Ensure that the correct target models (skins) have been installed on the PTS stands to be used. Ensure that flying targets to be used during the day's activities have retro-reflectors securely mounted before launching the aircraft. Further, if Vulcan or PIVADS will be exercised with the LBS, ensure all PTS have mounted retro-reflectors, pointed toward the weapon when the target is in its proper orientation (as scripted in the scenario that uses that target model). Reflectors are installed in pods which come with mounting brackets.

Establishing Voice Communications

Portable radios are used to communicate between the system operator (RCS-PLS) and target pilots or other personnel down range. If the DAS and RCS are not close together, the DAS operator will require a radio also. Energize the portable radios by installing fully charged battery packs. The batteries should be placed overnight in battery chargers when not in use. Verify communications to all those occupying the portable radio net.

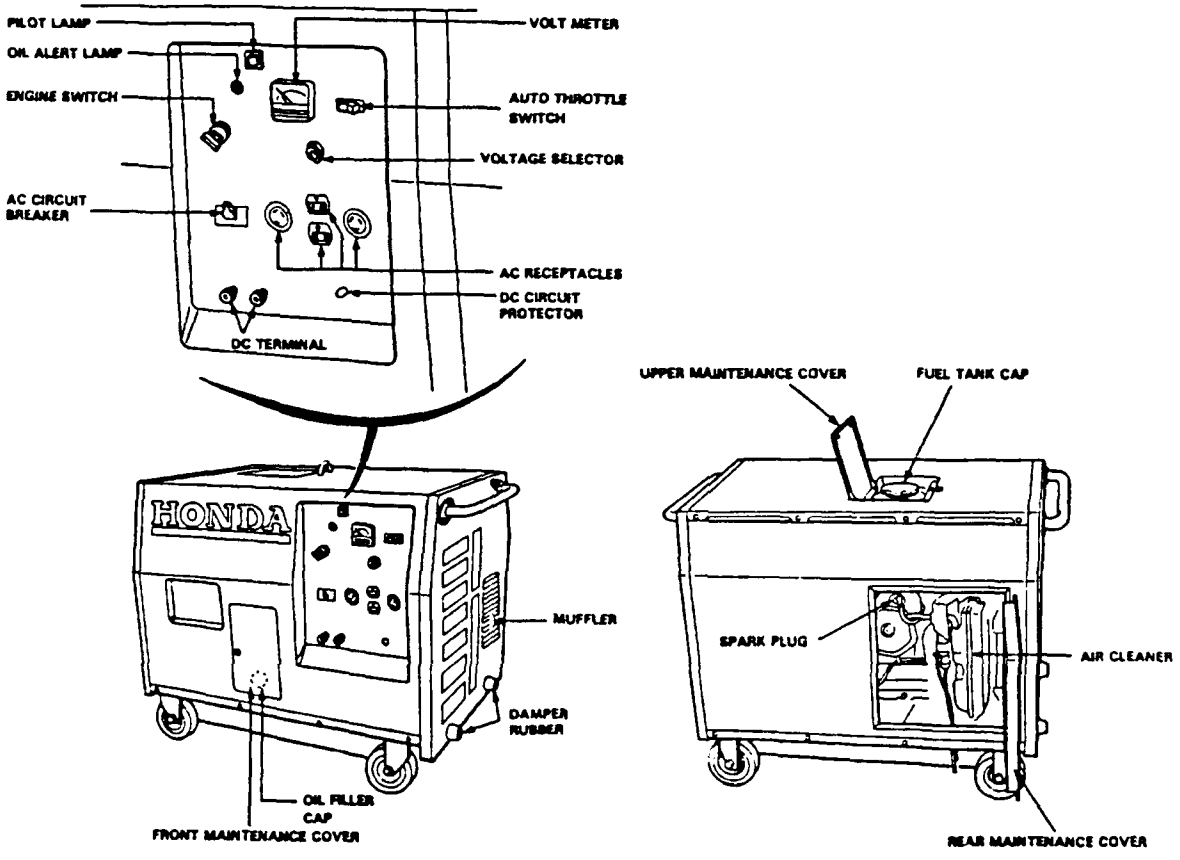
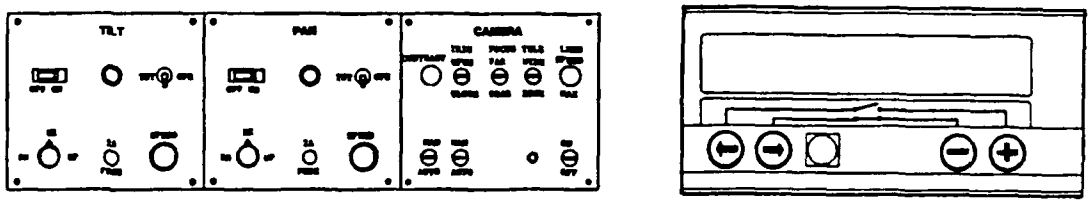


Figure 28. Generator Control Console



PLS CONTROL
** MOUNTED IN PLS CASE

BT-53 CONTROL
** MOUNTED IN TRAILER

Figure 29. PLS Control Consoles

Registering RTS Components

Registration of the system results in the geographic location of all major RTS components. To accomplish this, the PLS station is used as a site survey device.

Preliminary coordinates for various components should be derived before conducting registration. This is done by inputting desired ranges and azimuths of these components, as referenced from the DAS (point zero), into the RTSETUP program. These coordinates can be compared to those obtained during registration to determine the degree to which position-location of equipment meets requirements. Refer to RTSETUP Section ("Maintain Positions Menu") for more information on establishing preliminary coordinates using the RTSETUP program.

To begin registration, select the "Test" option from the RCS Main Menu. This is done by positioning the highlighter over that option using the arrow keys and pressing <ENTER>. Then select the "PLS" suboption using the same procedure. The PLS will determine the new RTS coordinates whenever it is aligned with a laser retro-reflector. These coordinates will be displayed at the RCS and should be manually recorded on paper to be input at a later time into the RTSETUP program.

Voice communications are required at the PLS to communicate with a forward spotter down range who should have a portable radio. The spotter will travel to the various positions that must be registered using an all-terrain vehicle. The spotter should have a laser retro-reflector attached to a long pole. The spotter will place a stationary mark or stake in the ground at each location being permanently registered to eliminate confusion as to where to emplace the equipment.

Contact the forward spotter on the radio and request that the laser retro-reflector pole be raised. Align the laser with the retro-reflector using the trackball. Alignment can be confirmed by viewing the camera display screen. Once aligned, the RCS will display the current coordinates, indicating the position relative to the weapon (i.e., DAS). Repeat this procedure for registering additional components.

To commence registration, the PLS position must first be established. The PLS orientation circle should contain all azimuths to which the PLS will be directed (e.g., all flight paths, all launch points, all PTS, and all RTS stations). The center of the circle is typically 0 or 180 degrees, and can correspond to the PTL of the DAS and weapon. The minimum effective range of the PLS is 75 meters. Any RTS component being registered which is closer than that must be surveyed manually (easily derived given the coordinates of the PLS and components beyond the 75 meter limit).

Once the PLS position has been established, the DAS is registered. The DAS is the reference point for all other components. (Note: If there will be more than one weapon position, the station called "REG" will establish the point of reference for all other locations.) It is a good practice to position the PLS, RCS, and DAS at the same location. Typically, the DAS position is given the default values "0,0" for the X and Y coordinates, and "180" as the orientation (i.e., down range, or the weapon PTL). All subsequent component locations will be registered in terms of their deviation from point zero (the DAS). If the PLS is at a different location than the DAS, it will generally have a negative Y coordinate (i.e., located behind the DAS and the weapon crew's search sector).

The RCS is registered next. The PLS and RCS should be collocated, since the same person usually operates both stations. Locating the PLS, RCS, and DAS in the same general area and using the default coordinates 0,0 to define that location, allows for more control over range operations and simplifies matters since the same location coordinates apply to all three stations.

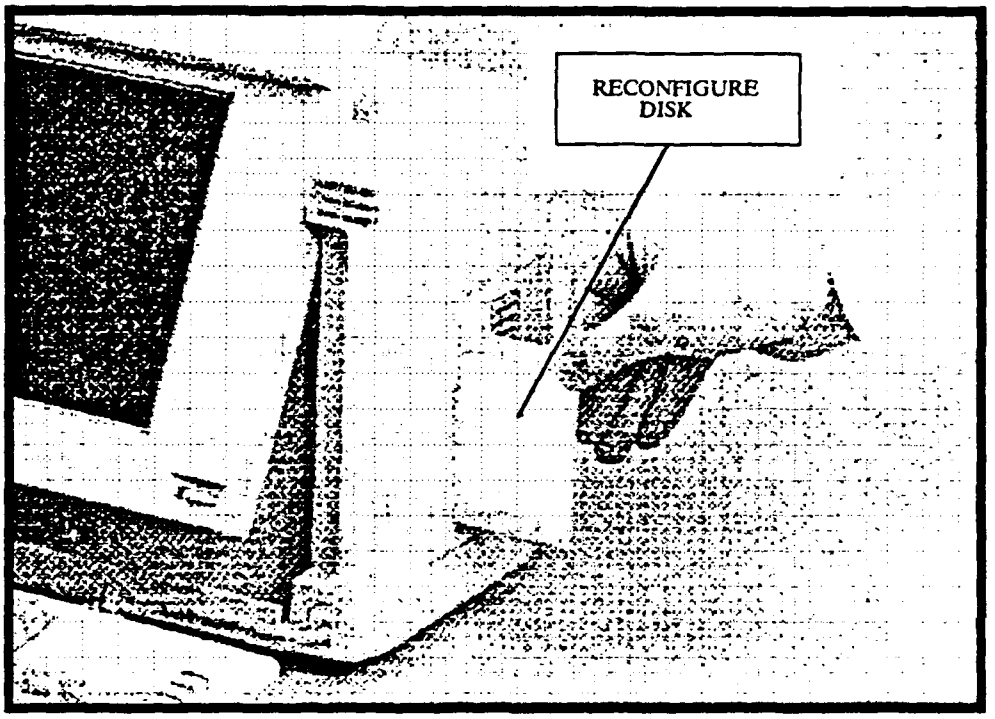
The FTS launch position(s) and the PTS positions always need to be registered as they will not be located in the operations control area. Registration of these locations can be somewhat tedious. This is because the exact locations are not known to the spotter located down range. Trial and error is usually involved in establishing the correct range and azimuth. Terrain and intervisibility requirements may result in compromises to the planned locations. Up to twelve PTS are registered. These pop-up helicopter targets are assigned numbers (i.e., 1, 2 . . . 12) during RTSETUP, and are usually registered in numeric order.

Once all components have been registered, the coordinates should be entered into the RTSETUP program. The "Maintain Positions Menu" option is used to input all system component coordinates (refer to RTSETUP chapter). This process is performed only once, unless new locations are desired. Sometimes, after the components are emplaced, terrain intervisibility requirements dictate the need to adjust the locations of targets. These adjustments are usually minimal. New positions must be registered and input into RTSETUP any time components are relocated. Otherwise the parameters are permanent for that site.

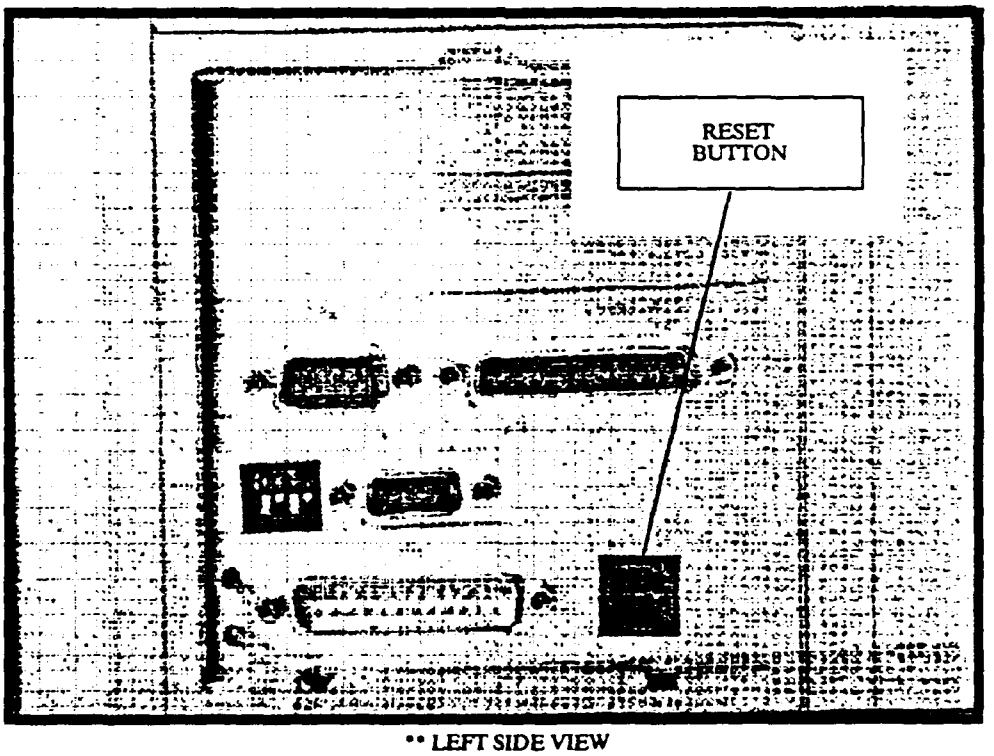
Reconfiguring the Stations

RTS arrives with station software already installed. Each station will be configured accordingly whenever it is energized. The RCS and DAS can be reconfigured to act as either station by performing the station software installation procedure. Insert the desired diskette (labeled either "DAS" or "RCS" "Reconfiguration Disk") into the disk drive and reboot the computer by pressing the <RESET> key (refer to Figure 30). Automatically the station will be configured to perform as the station denoted on the diskette.

The DAS should always be configured to receive data from the weapon system to be employed. If this weapon is different from the weapon system used previously, the weapon code must be changed before energizing the DAS. This is done at the RCS using the RTSETUP program. This process is performed using the "Maintain Positions Menu" and the "DAS" postition option (refer to RTSETUP chapter).



** RIGHT SIDE VIEW



** LEFT SIDE VIEW

Figure 30. Disk insertion and resetting the computer

Operations

This chapter presents the operations conducted during and at the close of a training or test application. RTS is composed of three major operation stations: the Range Control Station (RCS), the Data Acquisition Station (DAS), and the Position-Location Station (PLS). Each station operates using interactive menus. Selection of a menu option results in the display of available options at the next level in the menu hierarchy.

A highlighter (presented in reverse video to the rest of the screen) will appear on the menu screen over the first available selection. (Note: example screens do not show the reverse video highlighter.) The highlighter can be moved to the desired menu option using the arrow keys and the option highlighted can be selected by pressing the <ENTER> key. Pressing the <ESC> key will automatically return the operator to the previous menu in the menu hierarchy for that station. Each station is described below in terms of the associated menus and their functions.

Range Control Station (RCS) Operations

Once the RCS is energized, the RCS Main Menu will appear (see Figure 31). The main menu can also be activated by typing "RTS" after the operating system prompt (C:\RTS with flashing "-" cursor). This procedure can be used to activate all system stations (e.g., the DAS and PLS, also), but is not normally performed. The option "Test" will be highlighted initially, but any option can be selected by moving the highlighter with the arrow keys. The "Test" option has two suboptions: "PTS" (pop-up helicopter target system test) and "PLS" (position-location system test).

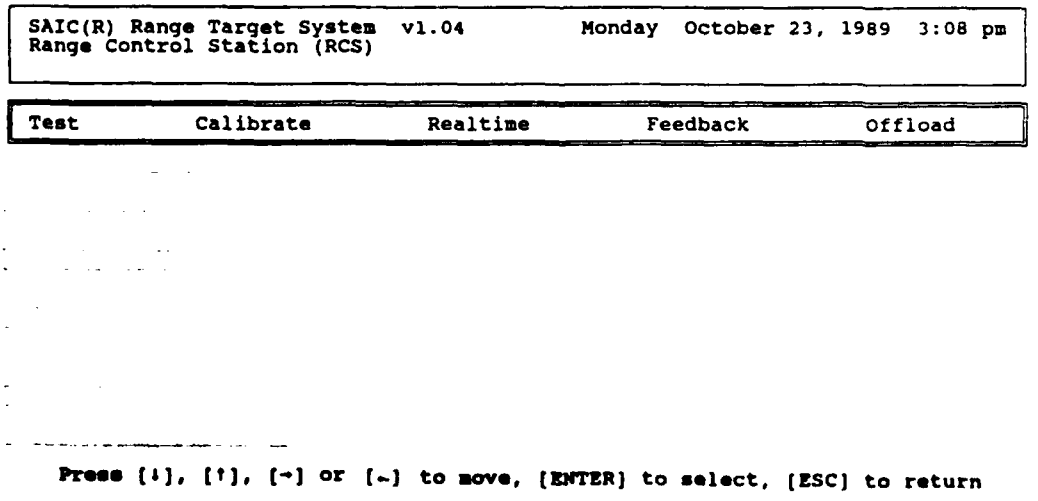


Figure 31. RCS Main Menu

PTS Test. Selection of the "PTS" option will result in the display of the PTS target numbers (1 through n) associated with the current system configuration. This display will appear on the left of the screen (see Figure 32). Each target system should be tested to ensure operability. Press <ENTER> to select the desired helicopter number.

For example, if PTS (target) #8 is selected, the PTS commands display will appear at the center of the screen (see Figure 32). Each function is tested as follows: "Up" (raise the target), "Rotate CW" (clockwise), "Rotate CCW" (counterclockwise), "Orient" (to a desired aspect orientation), "Smoke" (release weapon kill effects), and "Down" (lower target). Ensure that the helicopter is responding to the keyboard commands (may require binoculars). "Stop" can be selected to terminate one of the above functions (e.g., stop rotating clockwise). (Note: The normal resting point of the helicopter skin is zero degrees aspect, facing the weapon). "Status Request" will result in the display of PTS parameters for that target at the right of the screen (see Figure 32).

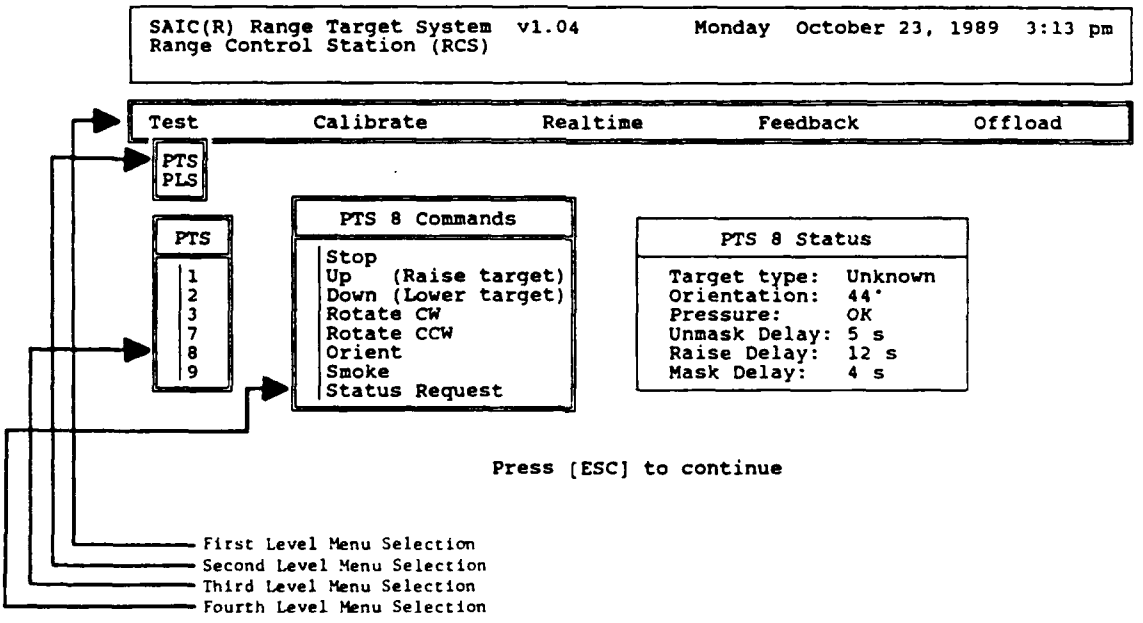


Figure 32. PTS Test Menu (RCS)

PLS Test. This is for testing the functions of the laser tracking system. A laser retro-reflector should be mounted on one of the raised helicopter stands or at some known location down range (e.g., launch site). The selection of the "PLS" option under the "Test" menu results in the display of PLS commands on the left of the screen (see Figure 33). Select the "Track" option to display the track data associated with the current orientation of the laser. The tracking display will appear at the right of the screen (see Figure 33).

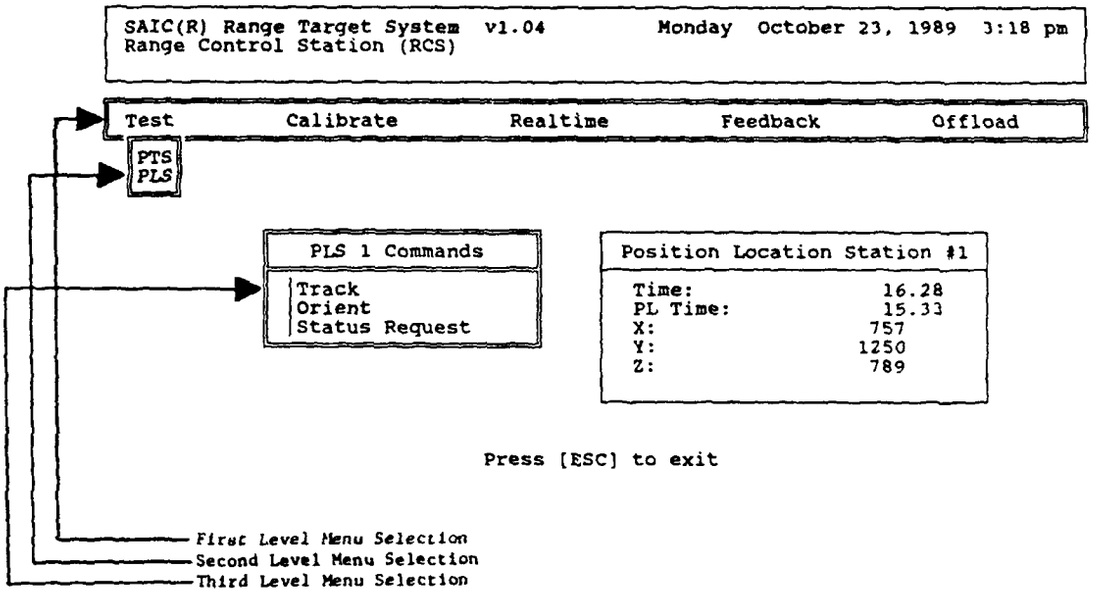


Figure 33. PLS Test Menu (RCS) -- track option

The "Orient" option is used to automatically orient the laser to a known position. The display will prompt the operator for the position number which is typically associated with a launch and recovery area for flying targets (see Figure 34). This enables the operator to quickly orient the laser so that it will be ready to track the next target to be launched from that location. The "Track" and "Orient" options enable the verification of known system component locations, or the determination of new locations.

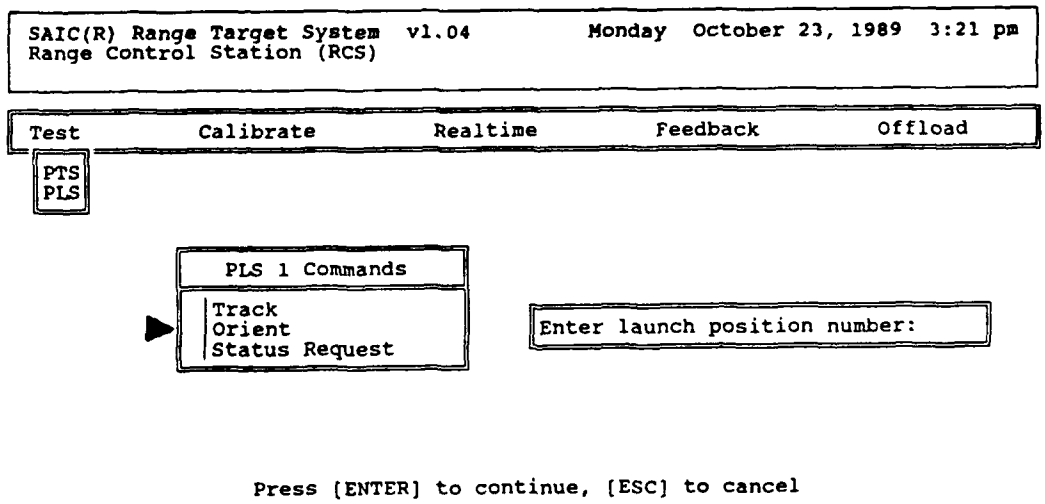


Figure 34. PLS Test Menu (RCS) -- orient option

Select the "Status" option to display the current azimuth and elevation of the laser on the right of the screen (see Figure 35).

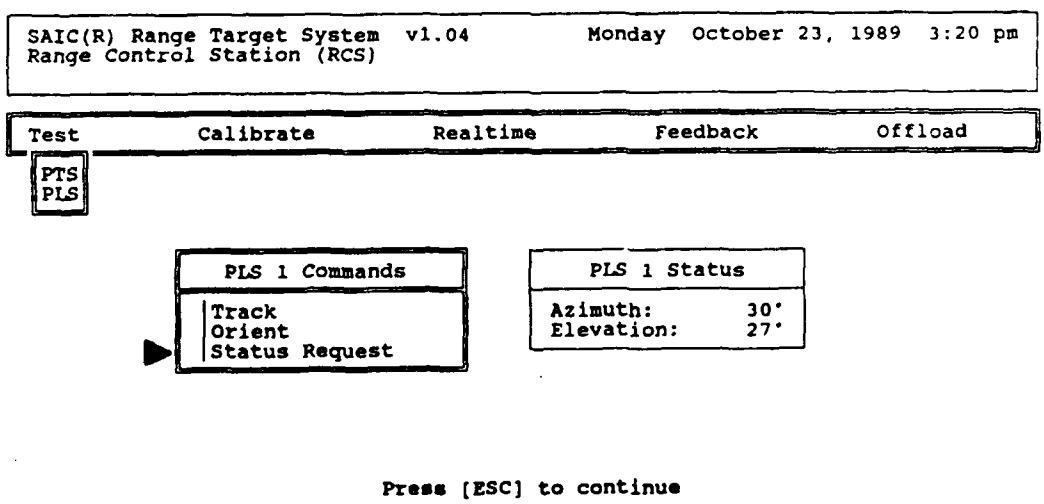


Figure 35. PLS Test Menu (RCS) -- status option

Calibrate. This is the next option in the RCS main menu. Each PTS must be calibrated prior to using the RTS for performance testing and evaluation; the defaults which appear initially will not be accurate. Each target should be calibrated in sequence three or four times when the system is initially emplaced. Targets will not require calibration again unless they are repositioned. Selection of this option results in the same display of PTS target numbers as "Test" does. For example, if PTS #8 was selected, the screen would display commands for that target in the center (see Figure 36).

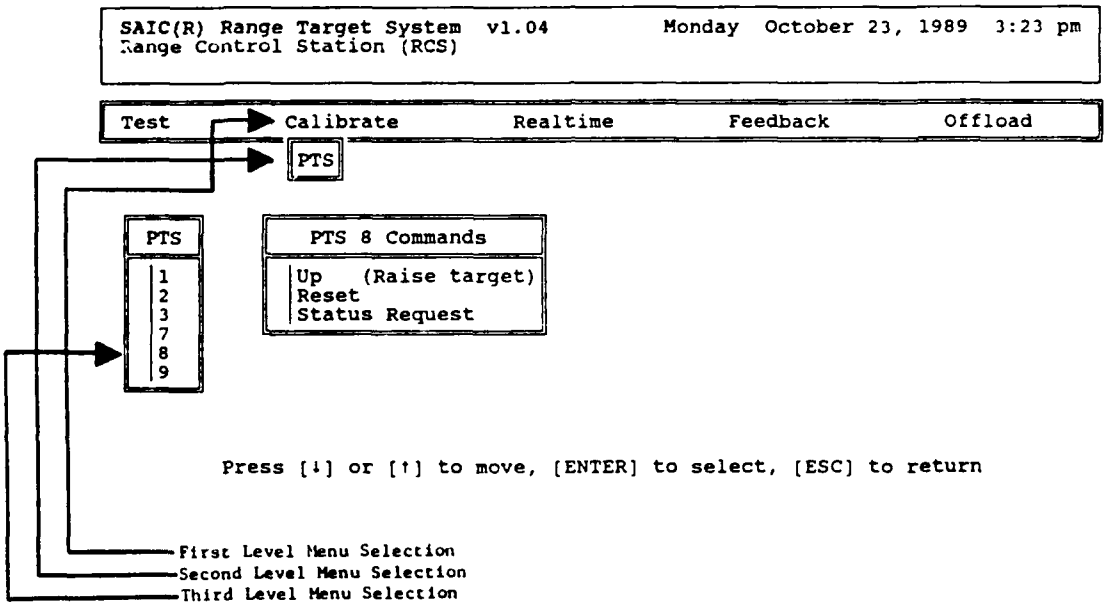


Figure 36. PTS Calibrate Menu (RCS)

The operator will then select "Up". The operator must press the < ENTER > key immediately when the target first appears, thereby calibrating the "Unmasked" time. The operator again presses < ENTER > when the target is in its fully raised position, thereby calibrating the time for "Raised". Next the operator selects and enters "Down", and then presses < ENTER > when the target is no longer visible, thereby calibrating the time for "Masked". Each step is fully prompted and interactive (see example screens in Figure 37). In other words, the system automatically selects the options in order, requiring the operator to press only the < ENTER > key to calibrate each function.

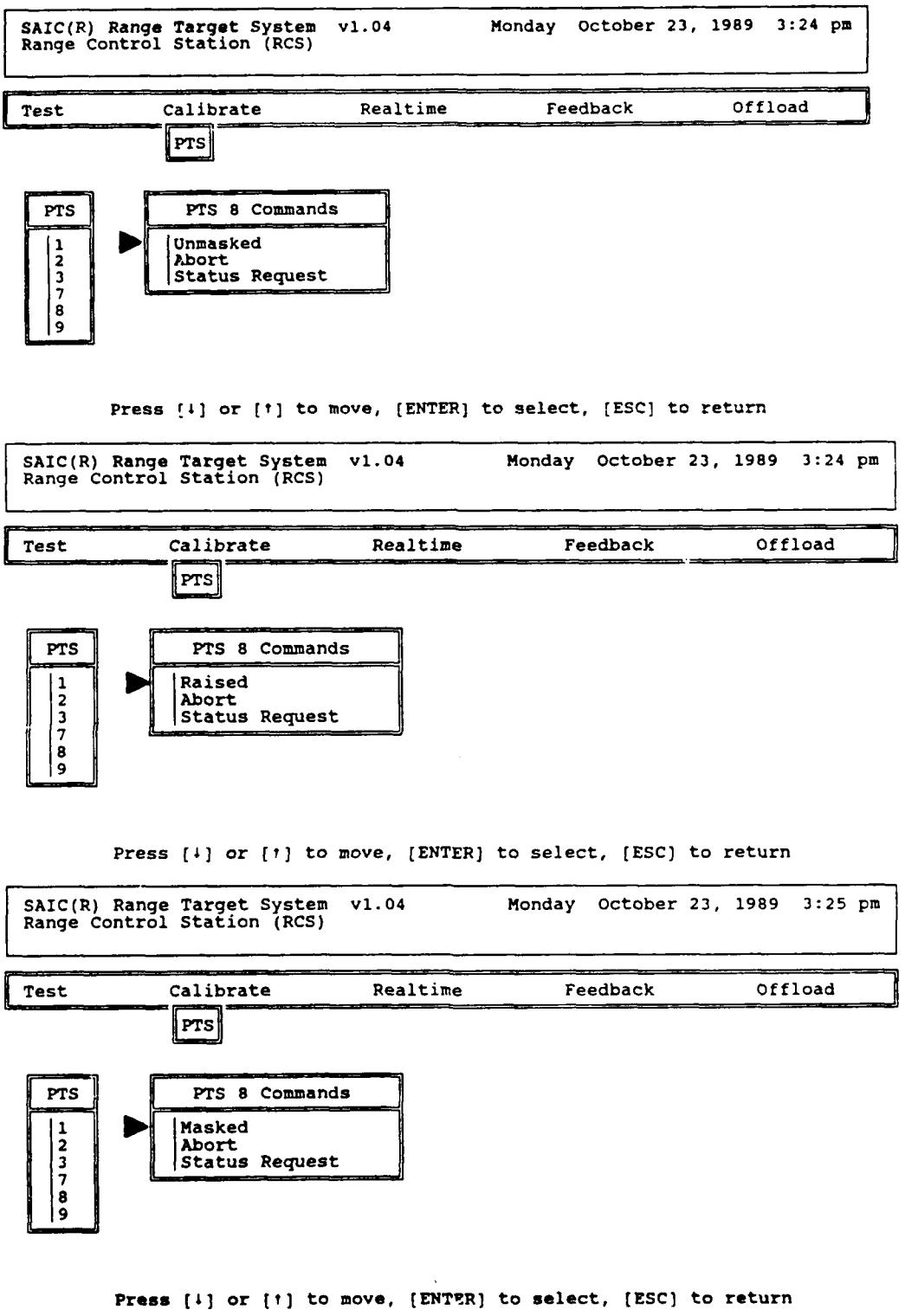


Figure 37. PTS Calibrate Menu (RCS) -- procedures

Each time the process is repeated for a given target, the computer will derive the average over all samples for each calibration event. This and additional target information can be displayed by selecting the "Status" option. The information will appear at the right of the screen (see Figure 38). (Note: "Target Type" has not been implemented and will display "Unknown".)

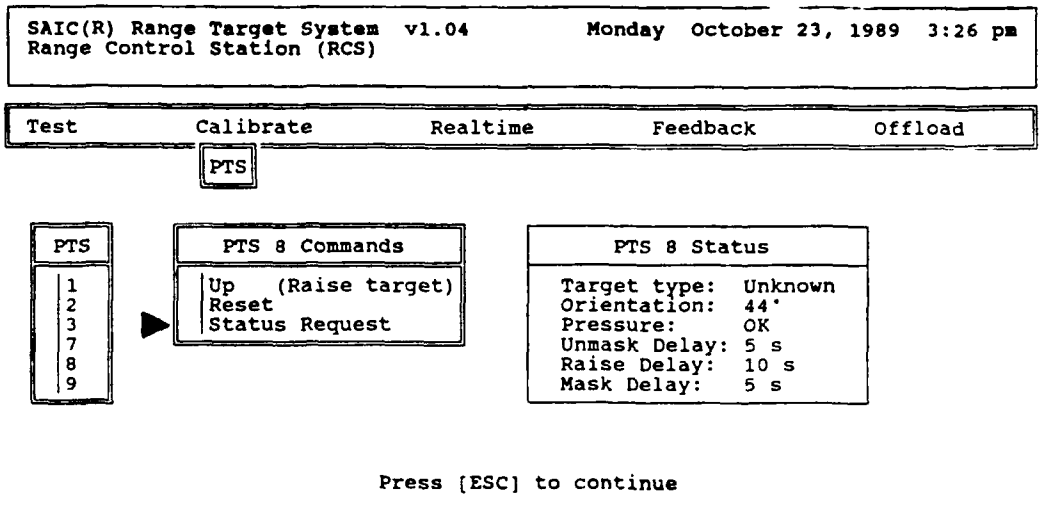


Figure 38. PTS Calibrate Menu (RCS) -- status option

Selection of the "Abort" option during the calibration phase results in the deletion of the current sample being taken. The "Reset" option is seldom, if ever, used. It will result in the default options associated with all targets to be entered for that target. It is better to calibrate each target separately, rather than use global defaults, as there will be variation among targets due to terrain variations.

The next option in the RCS Main Menu is "Realtime". Execution of Realtime is a sequentially prompted process. The first procedure is to select a scenario by pressing <ENTER> when that option appears (see Figure 39).

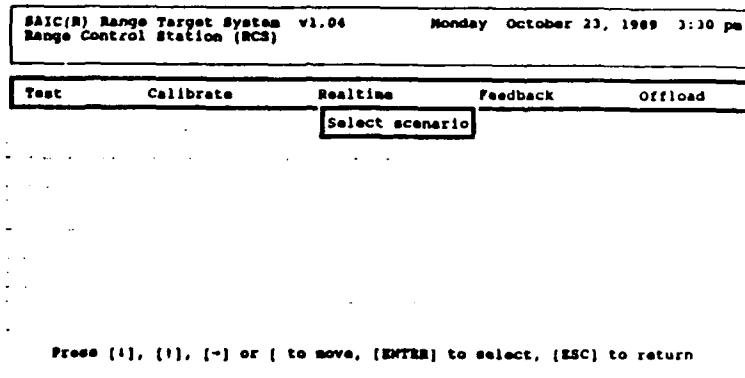


Figure 39. Realtime Menu (RCS)

Selecting scenarios. Operators at the DAS and the PLS should be in their respective main menus before selecting scenarios from the RCS "Realtime" menu. If not, press <ESC> until the stations are in their main menus. Scenario numbers can be chosen from any of those which were loaded during RTSETUP. The scenario library includes many scenarios of varying performance difficulty. Pressing the <ENTER> key will result in the selected scenario being initialized.

For example, if scenario 309 was selected and entered, the result would be a display of information pertaining to that scenario (see Figure 40). The operator can verify the associated information for each target and other scenario specifications by scrolling down through each field using the arrow keys, and checking the information against scenario listings generated using "RTS Tools" (refer to chapter on RTSETUP).

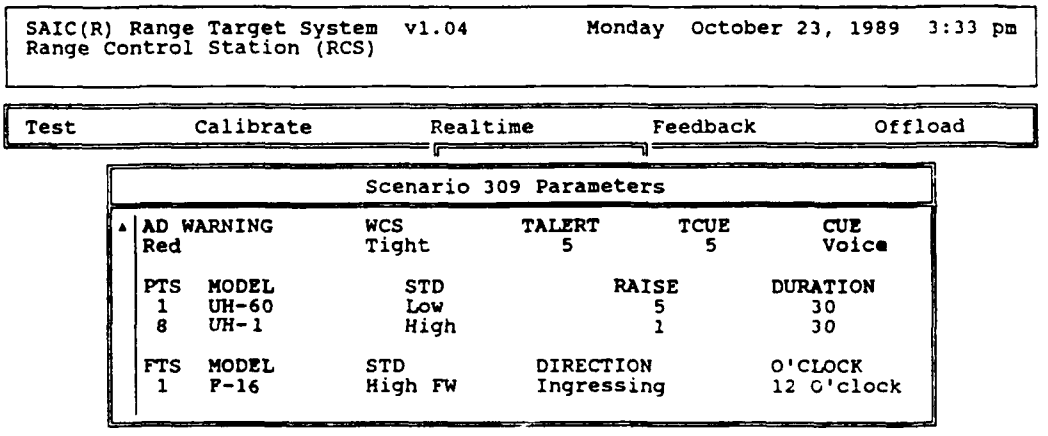


Figure 40. Realtime Menu (RCS) -- select scenario option

If this information is correct, the operator will press <ENTER> (see Figure 41). The operator is then prompted to enter or change aircraft scale (the default is 1/5 scale) and launch position (the default is 1). If the current selections are correct, the <ENTER> key is pressed. If not, the delete key is pressed, followed by typing the proper number, followed by pressing <ENTER>.

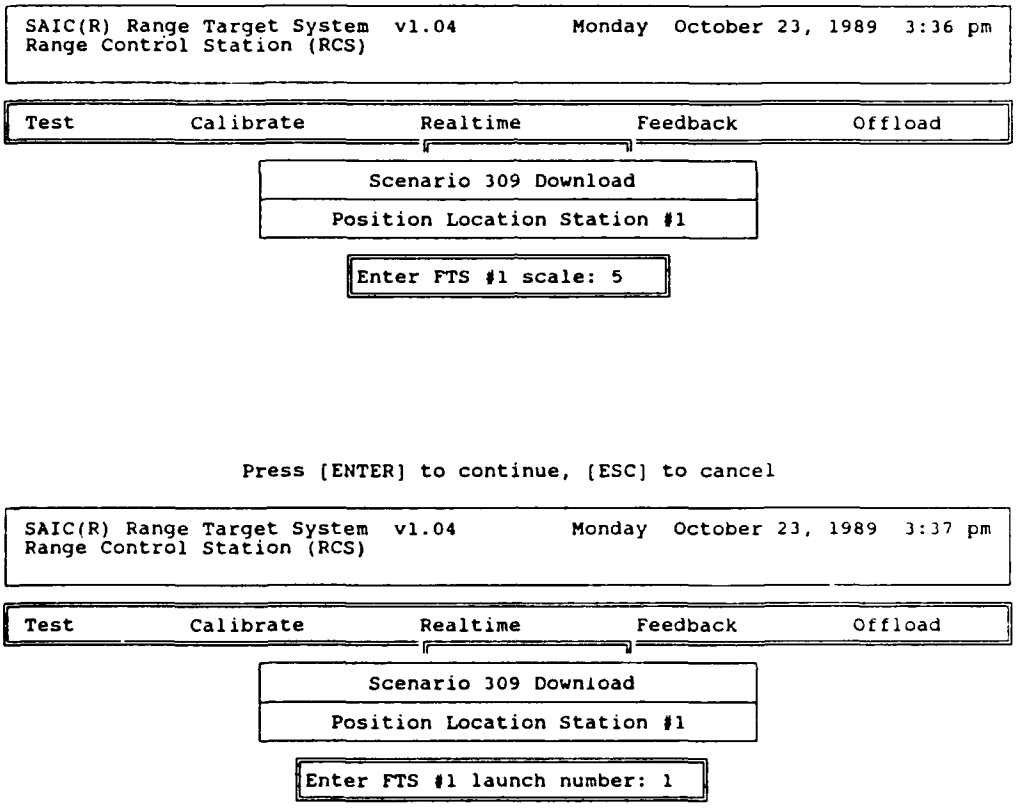


Figure 41. Realtime Menu (RCS) -- scenario download

The result is the automatic downloading of the scenario information to the DAS (such as the PTS stands and targets to be used in this scenario), and the activation of the PLS. A successful download will result in the display of status information of the PTS, PLS, and DAS. The operator should verify that all information is correct. For example, if the desired orientation of a PTS target is 45^{o} and the current orientation is 177^{o}, the correct target orientation must be implemented before proceeding. Refer to Figure 42.

```
SAIC(R) Range Target System  v1.04          Monday  October 23, 1989  3:39 pm
Range Control Station (RCS)

Test          Calibrate          Realtime          Feedback          Offload

                              Scenario 309 Setup

PLS  AZIMUTH ELEVATION
 1      26°        23°

PTS  MODEL (EXP) ORIENTATION      MODEL (ACT) ORIENTATION     PRESSURE
 1   UH-60              45°       Unknown           177°       OK
 8   UH-1               45°       Unknown            44°       OK

DAS  CREW   REP   SQUAD LEADER   GUNNER        WEAPON
 1    15     0                                PIVADS 20mm Gun Sys.

Press [↓] or [↑] to view, [ENTER] to continue, [ESC] to cancel
```

Figure 42. Realtime Menu (RCS) -- scenario verification

The RCS operator will then verify that the right crew number and repetition number are displayed with the DAS status information. The repetition number corresponds to either the first, second, or nth time the scenario has been presented to this crew, and is automatically assigned by the computer each time the scenario is executed for that crew. The first time a crew sees a scenario is the 0th repetition of that scenario. The second time a crew sees a scenario is the 1st repetition, and so on. Rather than simply repeating a scenario, it is often better to select one of equivalent difficulty that the crew has not seen before.

If there are discrepancies that need to be fixed, pressing the <ESC> key will terminate this scenario initialization. If the information is correct, the operator presses <ENTER> to proceed. This will result in the display of the range fan (weapon crew's search sector), with the PTS target positions, and flying target tracking information presented (see Figure 43).

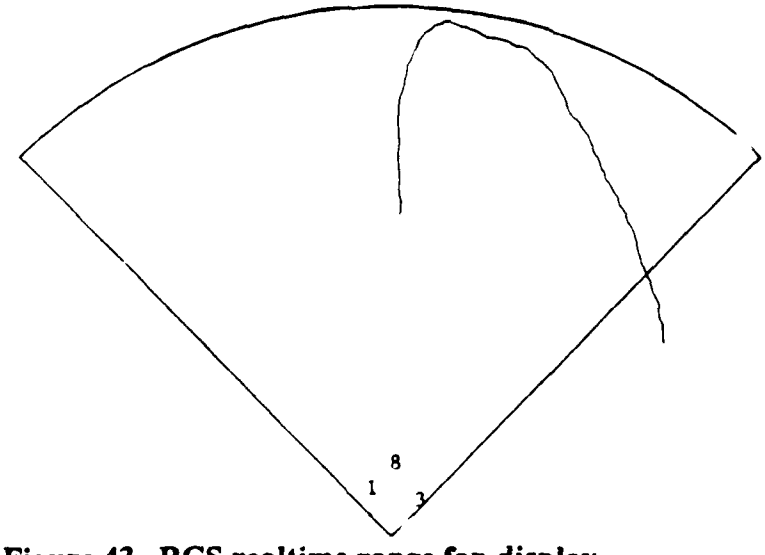


Figure 43. RCS realtime range fan display

Realtime operations. Once a scenario has been selected and verified at the RCS, and all systems are "go", realtime can commence. To execute realtime, which starts the clock beginning the scenario, the operator presses the <SPACE> bar. It is advisable to run a practice scenario to verify that the targets respond before presenting scenarios to troops. This is done once per day, prior to running scenarios to start the exercise.

The RCS operator will give the "start realtime" command to the system as soon as the target(s) is(are) at the logical start point. This is usually based on a specific alert delay time. For example, if a scenario having a flying fixed wing ingressing pattern is selected, the aircraft should already be airborne, should be at its farthest point from the weapon system, and should be ready to begin its scripted flight path into the weapon crew's defended area. Before starting, the RCS operator will ensure that the PLS is tracking the target smoothly, and that the track history is being displayed on the RCS computer screen. If smooth PLS tracking is lost, the PLS has a very large acquisition window, and if pointed in the correct general direction (using the trackball), it will pick up the target again automatically, and resume smooth tracking.

Realtime is terminated by pressing the <ESC> key when the target(s) is(are) no longer available and all data have been entered at the DAS. This action terminates realtime by issuing "STOP" messages to all RTS stations. Uploading of crew data from the DAS occurs automatically upon normal termination of realtime. Uploading is the transfer of the data files from the DAS to the RCS computer. When automatic uploading is completed, the DAS display will return automatically to the main menu, as will the RCS. In the event there is a communications failure, an error message will appear (see Figure 44). The operator may attempt a "Retry" by selecting "Yes". Continuous failures require maintenance action.

Premature termination can be invoked by simultaneously pressing the <CTL> and <END> keys, if a scenario abort is necessary. This will result in the loss of performance data on that scenario (i.e., DAS data upload is not performed).

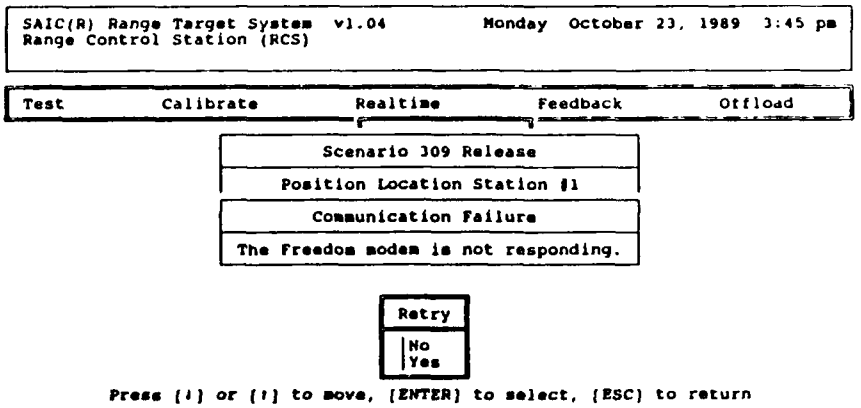


Figure 44. RCS realtime communications failure message

Feedback. This is the last option in the RCS Main Menu. (Note: The "Offload" option has not been implemented). The "Feedback" option is used to display performance data on trials. It is not the same as performance scoring feedback which provides average performance across scenarios of a given type and difficulty (see section on Post-Processing Operations). The operator will be prompted for the crew number, the scenario number, and the repetition number. After entering these data, feedback on each target presented (first, second, etc.) will be available. Feedback on preceeding or subsequent targets can be displayed by toggling forward or backward using the <TAB> keys (see Figure 45). The performance data can be compared to standards, which are also displayed, to determine if the crew if performing to standards. Task event ranges that are negative in value indicate that the FTS target was egressing when the event occurred (i.e., positive ranges are associated with ingressing aircraft events).

Scenarios can be executed without feedback if desired when the user wishes to present aircraft continuously without interruption. This can be done to support crew drills by repeating several like-difficulty scenarios for practice, for rehearsal of aircraft recongnition, or for gunner tracking training. Targets can be presented via the RCS using either of two methods: use the "PTS Test" menu to raise and lower pop-up targets, or present actual scripted scenarios using the "Realtime" menu. If the Realtime RCS menu is employed and the DAS has been disabled, the operator will see two error messages regarding a lack of communication with the DAS. The operator will respond "No" to the "Communications Failure, Retry?" message and "Ignore" to the "Abort or Ignore" message to bypass the DAS.

SAIC(R) Range Target System v1.04 Monday October 23, 1989 4:12 pm
Range Control Station (RCS)

Flying Target #1

Crew	16	TPM	Range	Status	Criteria
Squad Leader		DET	5770	Fails Criteria	8000
Squad Gunner		ID	5581	Meets Criteria	4000
		IFF	5507	Fails Criteria	6000
Model	F-111	CSF	5540	Meets Criteria	3500
Difficulty	High FW	LOC	5358	Meets Criteria	4000
		SEL	5322	Meets Criteria	4000
		FIR	5284	Meets Criteria	2000
Weapon	Stinger Basic Msl				
Effect	KILL				

Press [TAB] to change screens, [P] to print screen, [ESC] to exit

SAIC(R) Range Target System v1.04 Monday October 23, 1989 4:11 pm
Range Control Station (RCS)

Popup Target #1

Crew	16	TPM	Time	Status	Criteria
Squad Leader		AVL -> DET	36	Fails Criteria	4
Squad Gunner		DET -> ID	4	Meets Criteria	5
		ID -> ENG	1	Meets Criteria	1
Model	UH-60				
Difficulty	Low				
Weapon	Stinger Basic Msl				
Effect	NONE				

Press [TAB] to change screens, [P] to print screen, [ESC] to exit

SAIC(R) Range Target System v1.04 Monday October 23, 1989 4:11 pm
Range Control Station (RCS)

Popup Target #8

Crew	16	TPM	Time	Status	Criteria
Squad Leader		AVL -> DET	7	Meets Criteria	10
Squad Gunner		DET -> ID	4	Meets Criteria	9
		DET -> IFF	12	Fails Criteria	6
Model	UH-1	ID -> ENG	1	Meets Criteria	1
Difficulty	High	DET -> ACQ	18	Fails Criteria	6
		ACQ -> LOC	1	Meets Criteria	6
		ACQ -> SEL	3	Meets Criteria	6
		LOC -> FIR	3	Meets Criteria	5
		DET -> FIR	22	Fails Criteria	15
Weapon	Stinger Basic Msl				
Effect	KILL				

Press [TAB] to change screens, [P] to print screen, [ESC] to exit

Figure 45. Feedback at the RCS

Data Acquisition Station (DAS) Operations

The DAS is energized the same way as the RCS. Once energized, the DAS Main Menu will appear (see Figure 46).

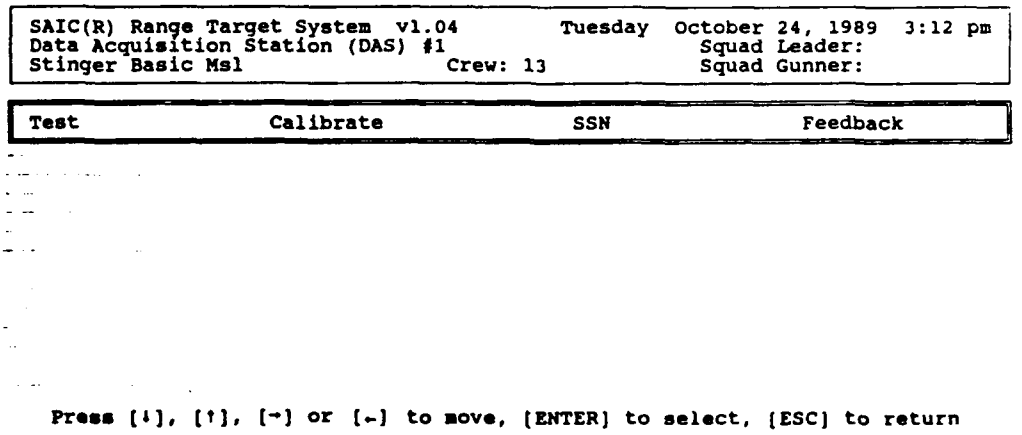


Figure 46. DAS Main Menu

The "Test" option allows for the testing of the PTS or the weapon system in use (see Figure 47). PTS test is identical to that of the RCS. The displays and test procedures are also the same.

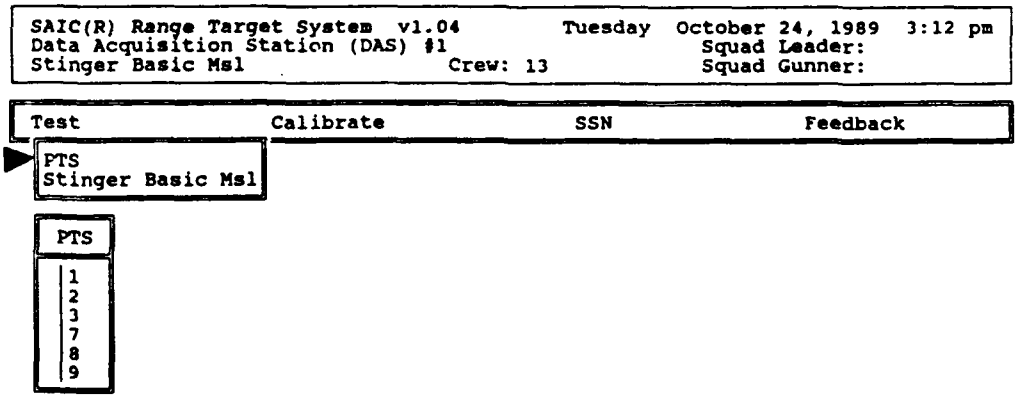


Figure 47. PTS Test Menu (DAS)

Weapon system test. The "Weapon" option under the "Test" menu pertains to the testing of the weapon system. Selection of this option results in the display of the weapon events (see Figure 48). Ensure that the correct weapon type code has been entered before performing the test (refer to chapter on RTSETUP). The operator must verify that each weapon event is being received at the DAS before executing any scenarios.

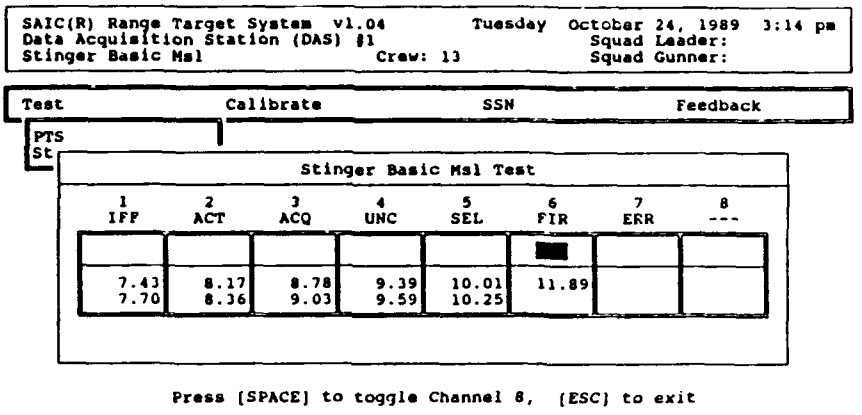


Figure 48. Weapon System Test Menu (DAS)

First connect the Weapon System Interface (WSI) to the DAS computer (refer to chapter on System Preparation and Installation). Then connect the "test connector" on the WSI (connect P2 to J2 as shown in Figure 49). The operator can now simulate the weapon events using the WSI switch panel to ensure the DAS is receiving inputs. Upon completion, disconnect the "test connector" (disconnect P2 from J2). Next, connect the weapon itself to the WSI (connect weapon cable to J2) to determine that the weapon is operational and the events are being received at the DAS. As each weapon switch is activated and then deactivated, the DAS computer should display these events as a function of time. The operator simply views the display while the gunner goes through the complete engagement process. If event entries are not displayed properly, restart the DAS computer and re-run this procedure. Call for maintenance if problems in receiving weapon inputs continue.

The "Calibrate" option of the DAS Main Menu pertains to PTS targets and is executed exactly the same way as with the RCS station. The displays and procedures are identical to those described earlier. PTS calibration is normally executed from the RCS, so this option is seldom, if ever, used.

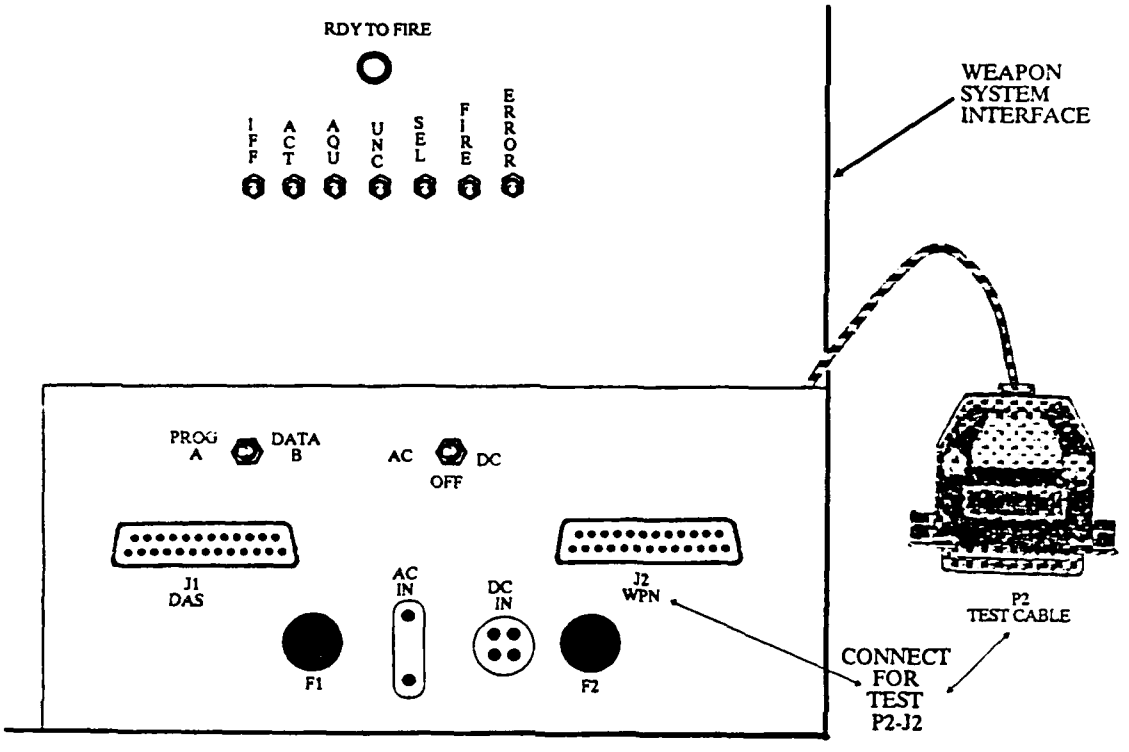


Figure 49. Weapon System Interface connections

Inputting crew Social Security Numbers. When the weapon and targets have been tested, the crew must then be identified by the system before executing any scenarios. This is done using the "SSN" option of the DAS Main Menu. The operator will select the squad leader and gunner options, respectively (see Figure 50), and will either enter or change the Social Security Numbers to coincide with those of the current crew. To reenter numbers, simply backspace over those displayed and type in the new ones. Press <ENTER> once the numbers are correct. This procedure is conducted only once for each crew, as long as that crew continues to be exercised.

The system will recognize if the crew is a repeat by matching the two SSN numbers. If either number is different (i.e., one or both members are new) the system will recognize them as a new crew. Further, if the weapon in use is different, even though the crew is a repeat, the system will recognize them as a new crew. Previous performance data for this crew can be recovered if both numbers match a previously existing crew for that weapon type.

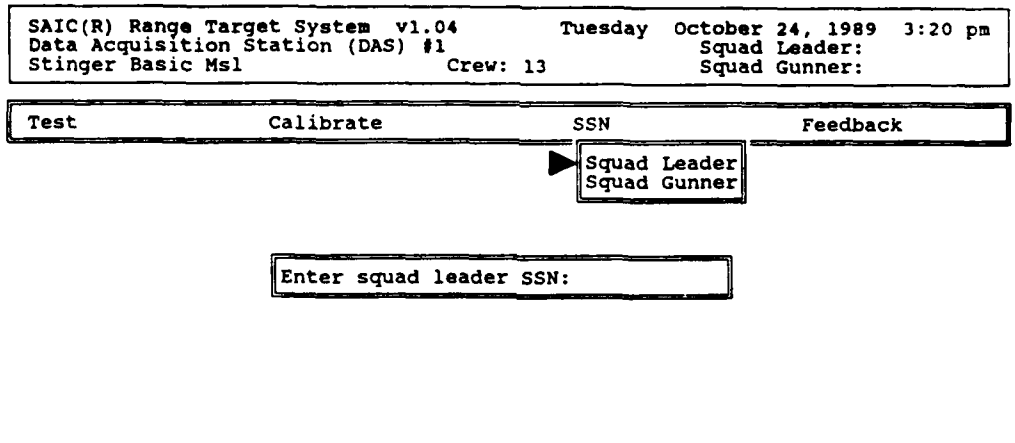


Figure 50. SSN Menu (DAS)

DAS Realtime data entry. Executing Realtime will result in the transmission of a data packet to the DAS, giving the information that the station needs to execute its part of the selected scenario (see DAS Realtime Display shown in Figure 51). The DAS is manned by a data collector (usually the instructor-evaluator) who monitors gunner events captured by the system and who manually enters squad leader events. All weapon and soldier actions are displayed on the DAS screen as they are entered (i.e., the time of event occurrence).

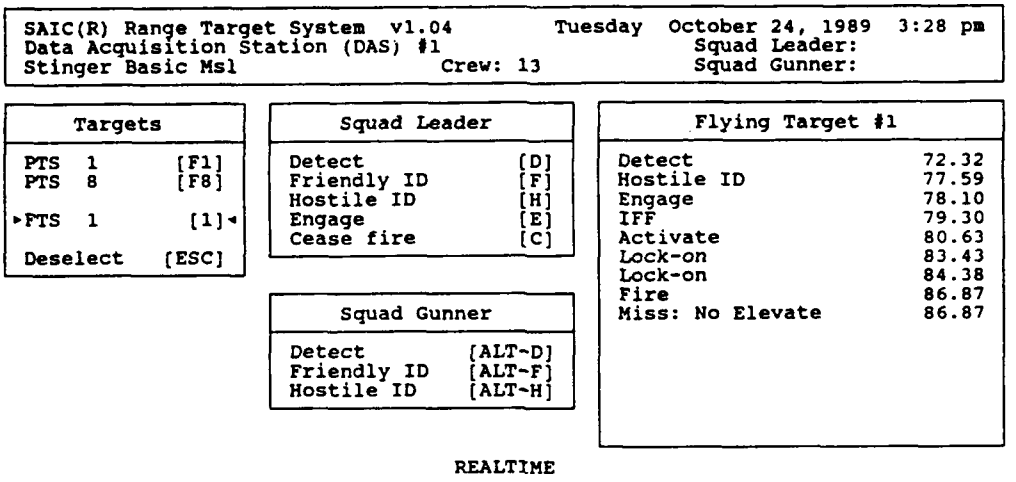
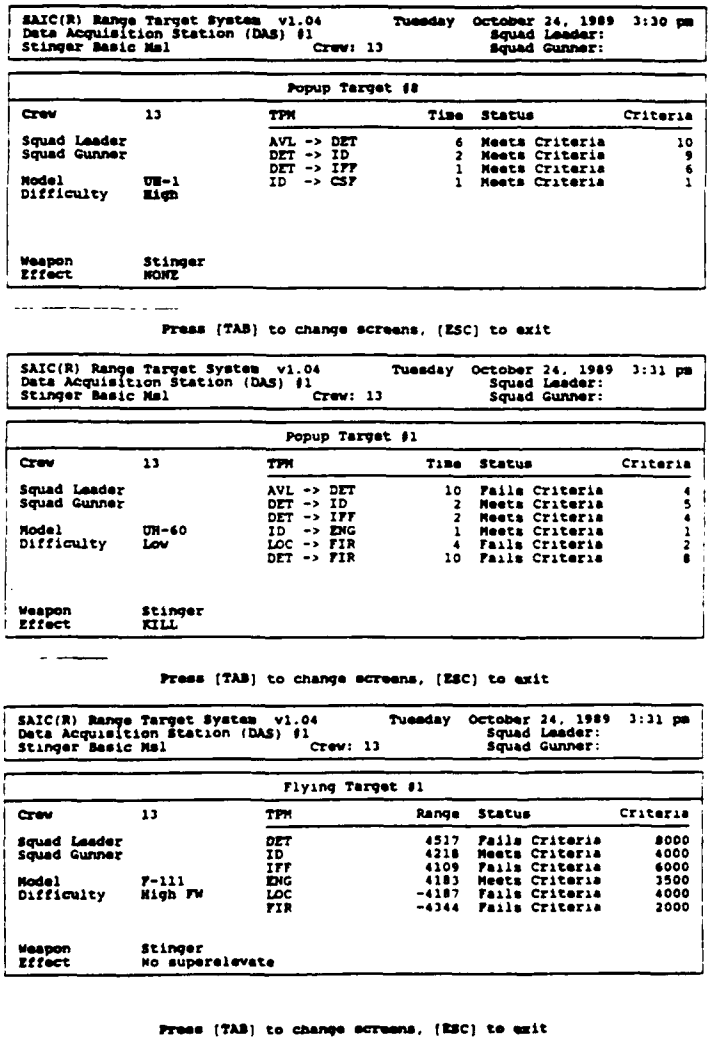


Figure 51. DAS realtime display

When a target becomes available to the weapon crew there will be an arrow displayed next to the target number (as shown in Figure 51) which corresponds to the keystroke designating that target. A <1> designates a flying target, and <F1> through <F12> designate pop-up helicopters (number corresponds to the target numbers previously assigned in RTSETUP). When the squad leader or gunner detects the aircraft and announces the word "contact", the DAS operator first enters the applicable target number (in the event of multiple targets) and immediately thereafter the DAS operator enters a <D> keystroke indicating detection. When the squad leader makes his identification and announces hostile or friendly, the DAS operator enters the appropriate letter key: <H> for hostile and <F> for friendly. When the squad leader gives his command to "engage" or "cease engagement", the DAS operator enters the appropriate letter key: <E> for engage or <C> for cease engagement. The above process is repeated for new targets being worked in that scenario. For single target scenarios, the target number is automatically selected so only the squad leader events need to be entered.

In addition to data entry functions, DAS operators monitor the gunner events which are captured directly from the weapon system circuits. As the gunner acquires the target, for example, and acquisition tone is heard, the tabular display should show that acquisition has occurred. If any of the gunner events fail to be logged by the system, this should be reported immediately after the end of the scenario trial to the system operator.

Feedback. This is the last option in the DAS Main Menu. This option is selected if the instructor-evaluator wishes to review or provide to the crew performance feedback on the last trial executed. Selection of this option results in the display of performance data along with the applicable standards for the level of difficulty of that scenario (see Figure 52). If there were multiple targets, subsequent target performance data can be viewed by toggling forward or backward using the <TAB> keys. This capability is also provided at the RCS. (Note: Negative task event ranges are associated with egressing FTS aircraft; positive event ranges refer to ingressing targets).



```
SAIC(R) Range Target System  v1.04          Tuesday  October 24, 1989  3:30 pm
Data Acquisition Station (DAS) #1                      Squad Leader:
Stinger Basic Msl                 Crew: 13             Squad Gunner:

                                Popup Target #8

Crew            13              TPM                 Time  Status          Criteria
                                ------------------------------------------------
Squad Leader                    AVL -> DET             6  Meets Criteria       10
Squad Gunner                    DET -> ID              2  Meets Criteria        9
                                DET -> IFF             1  Meets Criteria        6
Model           UH-1            ID  -> CSP             1  Meets Criteria        1
Difficulty      High


Weapon          Stinger
Effect          NONE

                Press [TAB] to change screens, [ESC] to exit

SAIC(R) Range Target System  v1.04          Tuesday  October 24, 1989  3:31 pm
Data Acquisition Station (DAS) #1                      Squad Leader:
Stinger Basic Msl                 Crew: 13             Squad Gunner:

                                Popup Target #1

Crew            13              TPM                 Time  Status          Criteria
                                ------------------------------------------------
Squad Leader                    AVL -> DET            10  Fails Criteria        4
Squad Gunner                    DET -> ID              2  Meets Criteria        5
                                DET -> IFF             2  Meets Criteria        4
Model           UH-60           ID  -> ENG            1  Meets Criteria        1
Difficulty      Low             LOC -> FIR             4  Fails Criteria        2
                                DET -> FIR            10  Fails Criteria        8


Weapon          Stinger
Effect          KILL

                Press [TAB] to change screens, [ESC] to exit

SAIC(R) Range Target System  v1.04          Tuesday  October 24, 1989  3:31 pm
Data Acquisition Station (DAS) #1                      Squad Leader:
Stinger Basic Msl                 Crew: 13             Squad Gunner:

                                Flying Target #1

Crew            13              TPM                 Range  Status          Criteria
                                ------------------------------------------------
Squad Leader                    DET                  4517  Fails Criteria     8000
Squad Gunner                    ID                   4218  Meets Criteria     4000
                                IFF                  4109  Fails Criteria     6000
Model           F-111           ENG                  4183  Meets Criteria     3500
Difficulty      High FW         LOC                 -4187  Fails Criteria     4000
                                FIR                 -4344  Fails Criteria     2000


Weapon          Stinger
Effect          No superelevate

                Press [TAB] to change screens, [ESC] to exit
```

Figure 52. Feedback at the DAS

Position-Location Station (PLS) Operations

Test. The PLS Main Menu has only one implemented option: "Test" ("Calibrate" is not implemented). Under this option, the operator can choose either "Track" or "Orient". The "Orient" option is identical to the "Orient" option used with the RCS (refer to "PLS Test" section). The displays and procedures are also the same.

Selecting the "Track" option results in a status display of the current PLS laser orientation (see Figure 53). This display provides the location of the current target coordinates and the azimuth and elevation of the laser. Provided to the right of these data is the error, if any, in azimuth and elevation (see Figure 53). If the target is being automatically tracked, the status display will show the messages: "Automatic" and "On Track" (see Figure 53). The PLS operator should monitor the camera display screen which will show the actual target and its background (sky or terrain).

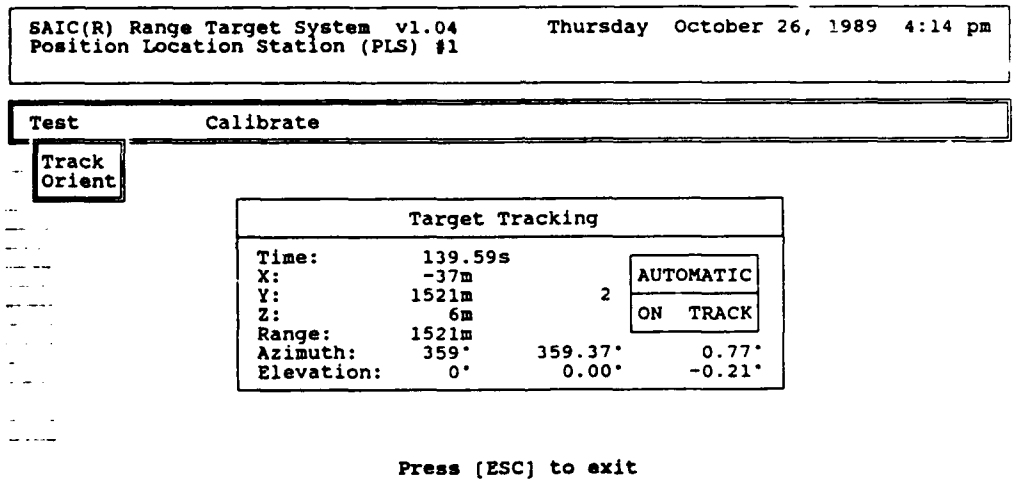


Figure 53. PLS automatic and on track message

If the laser loses track (i.e., the laser is not receiving the signal from the retro-reflector), the screen will switch to "Semi-Auto" mode and will flash the "Off Track" message (see Figure 54). This is also signified by a "beep" audio signal. The operator will also be able to see that the target is no longer visible on the camera display screen. In semi-automatic mode, the operator repositions the laser using the trackball until the target reappears in the camera display (described later in this section). This will result in the "On-Track" message returning, and the resuming of "Automatic" tracking mode.

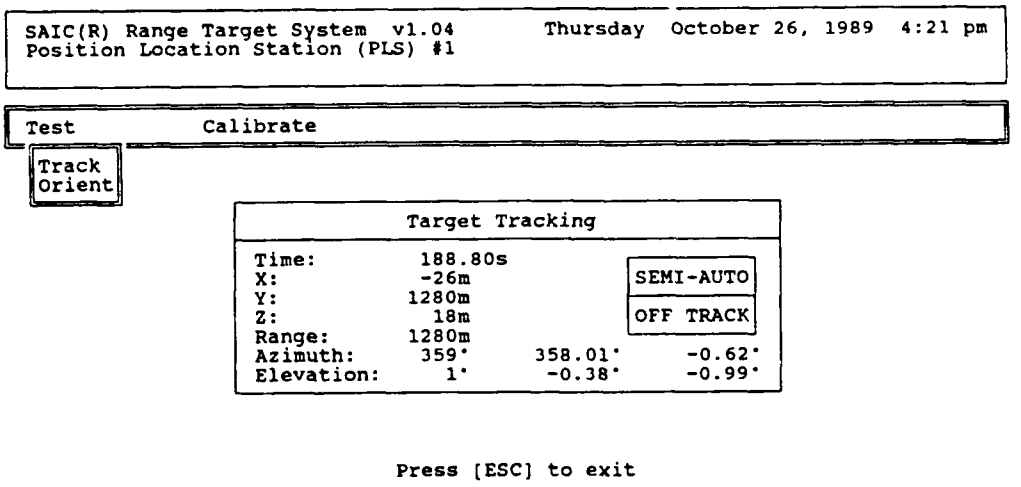


Figure 54. PLS off track message

In the event of a failure of the laser to operate (such as loss of power) the "Failed" message will appear (see Figure 55). This is an indication of a need for maintenance action.

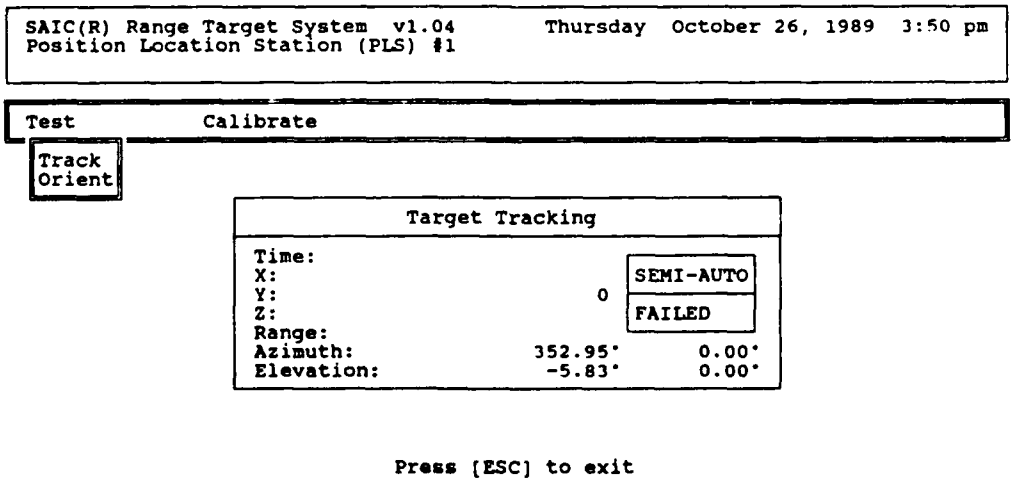


Figure 55. PLS failed message

If manual mode is invoked, the "Manual" message will appear (see Figure 56).

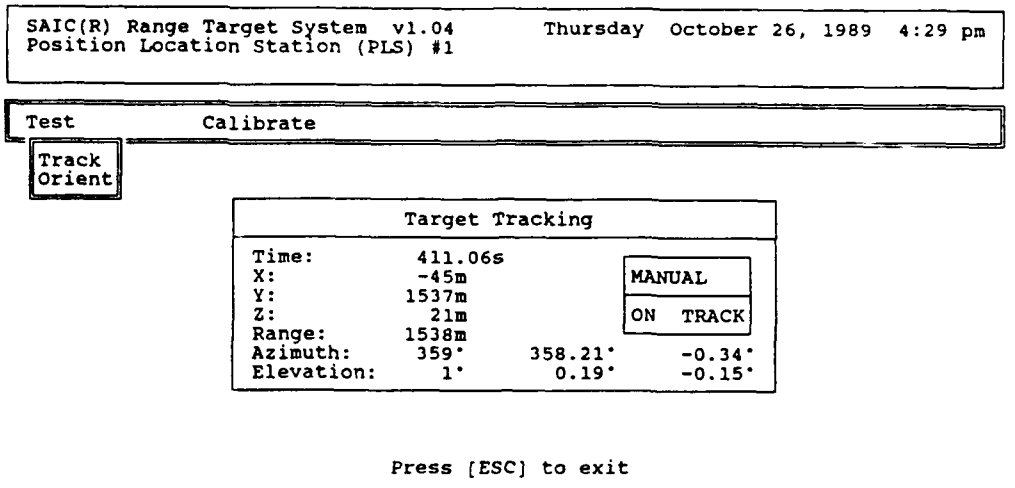


Figure 56. PLS manual and on track message

Manual and automatic tracking. Manual PLS tracking mode should be tested first during PLS Test. Press the left button on the trackball console (refer to Figure 57) to activate manual mode. Using the trackball, point the laser at a target, verifying alignment by viewing the camera display screen. The coordinates of the target and the azimuth and elevation of the laser should be consistent with the values obtained during registration of that position. Pressing the left button again will activate automatic tracking mode.

The PLS should then be tested to ensure automatic tracking mode is operating. Launch an aircraft with mounted laser retro-reflector or position someone down range with a laser retro-reflector mounted on a pole and see if the laser tracks the moving reflector. As long as the laser receives returns, the "On-Target" message will appear. If the laser loses the target, the "Off-Target" message will appear and the system will go to semi-automatic mode. This mode allows the operator to adjust the azimuth and elevation of the laser to realign it with the target using the trackball.

If the laser is tracking the wrong target, switch to manual mode by pressing the left button on the trackball control. (Pressing the middle button will interrupt the laser transmission of the current track. Pressing the right button will stop the laser at the current position.) Reorient the laser with the trackball so that it is on the correct target and reactivate automatic mode by pressing the left button again. It is sometimes necessary to periodically employ the semi-automatic mode when a flying target is maneuvering since the laser may lose alignment with the retro-reflectors on board the aircraft.

An audio alarm will sound when the PLS switches from one mode to another or when it loses track. Pressing the < SPACE > bar on the PLS keypad will turn the alarm off.

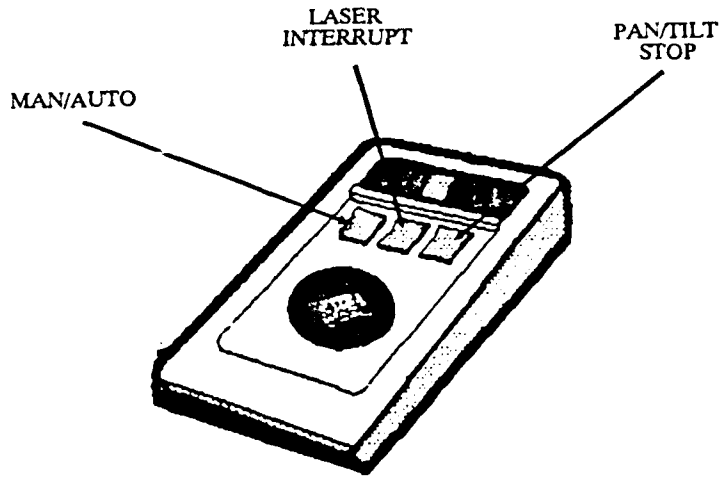


Figure 57. PLS Trackball Console

PLS trackball and Pan-Tilt-Camera controls. The trackball console is used to switch between manual and automatic PLS control (see Figure 57). The PLS control console (see Figure 58) enables the orientation of the Tilt mechanism (Up or Down) and the Pan mechanism (Clockwise or Counterclockwise). It also enables the adjustment of the PLS Camera: contrast, shutter (iris), field of view, zoom (wide-angle or telephoto), and tracking speed.

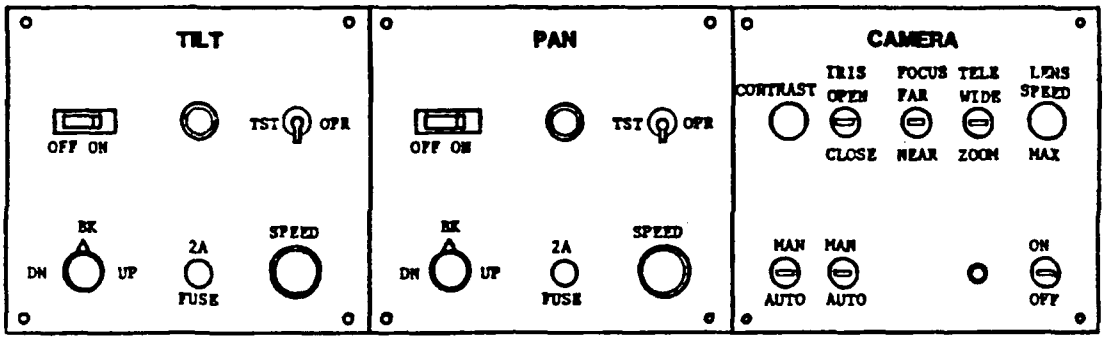


Figure 58. PLS Pan-Tilt-Camera Console

Post-Processing Operations

Performance scoring reports. Feedback on any scenario can be viewed at the RCS or the DAS computer display. The feedback displays provide the observed performance, performance criteria, and whether the crew was above or below the established criteria. These performance criteria serve as benchmarks from which the crew or operator performance may be fairly evaluated. Feedback at the DAS is available after a scenario has been completed and only that scenario can be fed back. However, any scenario trial can be fed back via the RCS and printed out on hardcopy by pressing the <PRINT SCREEN> key.

Summary feedback (scoring) over several scenarios can also be generated and printed at the RCS. Pressing the <ESC> key while in the RCS Main Menu, results in a prompt as to whether the operator wishes to terminate operations ("Exit RTS"). The default option is "Yes". Press <ENTER> to leave the RCS Main Menu and enter the operating system. Type "RTSCORE" after the prompt (-) and press <ENTER>. Press <ENTER> again to clear the screen of the software copyright screen. The system will then prompt for the crew(s) for which scoring is desired. After these data are entered the system will automatically score the performance overall relevant scenarios for both FTS and PTS scenario types, for each difficulty level, and for every crew requested. Table 2 presents examples of the scoring output. Performance scoring is usually performed at the end of a series of scenario test or training trials.

Offload. RTS will automatically upload data after each scenario. All performance data collected during the training or test session are subsequently stored in memory, making a permanent record of the soldiers' performance on each scenario. All weapon system realtime files uploaded from the DAS, all flight path files generated in realtime, all performance measures, and associated pass-fail determinations become stored. This information is easily retrieved for future reference.

Offload is executed from the RCS computer after the day's activities are complete to backup all of the above data files. This is done from the operating system. Escape to the operating system at the RCS using the procedure described above. Then place an empty and formatted floppy disk in Drive A to backup the files. The operator simply types "OFFLOAD" and presses <ENTER> which will automatically backup the data files to floppy diskette. Backup does not need to be performed when temporarily halting operations (i.e., during lunchtime, for feedback, etc.). However, when closing out operations for a specific crew, backup is recommended. Upon termination, the program will return the RCS to the operating system. Performance data are typically offloaded to diskette when the data collection application is completed. This diskette is taken to the analysis center for data reduction and statistical analyses.

Table 2

Performance Scoring Output

STAND RW TARGET DIFFICULTY=LOW

TASK PERFORMANCE MEASURES DIAGNOSTICS

TPM	MEAN	STATUS	CRITERIA
TIME OF DETECT	6.2	FAILS CRITERION	4
TIME OF ID	11.8	FAILS CRITERION	5
TIME OF IFF	4.7	FAILS CRITERION	4
TIME OF ENGAGE	0.4	MEETS CRITERION	1
TIME OF ACQUIRE	4.0	MEETS CRITERION	4
TIME OF LOCK-ON	4.0	FAILS CRITERION	2
TIME OF SUPER-ELEVATE	3.3	FAILS CRITERION	2
TIME OF FIRE	3.0	FAILS CRITERION	2
TOTAL TIME	14.3	FAILS CRITERION	8

PASS-FAIL DETERMINATION

SPM	SCORE	STATUS	CRITERIA
% DETECTED	83.3	FAILING	99
% IDENTIFIED	83.3	FAILING	99
% CORRECT ID	83.3	PASSING	80
% AC DESTROYED	66.7	FAILING	80
% HOSTILES ENG	100.0	PASSING	85
% FRIENDS CORR ID	50.0	FAILING	80
% HOSTILES CORR ID	100.0	PASSING	85
% ATTRITION	100.0	PASSING	68
% ORDNANCE RELEASED	25.0	FAILING	16

CREW: 7 11/28/89 12:31:31 WEAPON: STINGER
SQUAD LEADER SSN =
GUNNER SSN =

FIXED WING TARGET DIFFICULTY=MEDIUM

TASK PERFORMANCE MEASURES DIAGNOSTICS

TPM	MEAN	STATUS	CRITERIA
RANGE OF DETECT	14073	MEETS CRITERION	11000
RANGE OF ID	7055	MEETS CRITERION	6000
RANGE OF IFF	12966	MEETS CRITERION	8000
RANGE OF ENGAGE	6936	MEETS CRITERION	5500
RANGE OF LOCK-ON	6558	MEETS CRITERION	5000
RANGE OF FIRE	5747	MEETS CRITERION	4000

PASS-FAIL DETERMINATION

SPM	SCORE	STATUS	CRITERIA
% DETECTED	100.0	PASSING	99
% IDENTIFIED	100.0	PASSING	99
% CORRECT ID	100.0	PASSING	75
% AC DESTROYED	100.0	PASSING	70
% HOSTILES ENG	100.0	PASSING	80
% HOSTILES CORR ID	100.0	PASSING	80
% ATTRITION	100.0	PASSING	60
% ORDNANCE RELEASED	0.0	PASSING	35

CREW: 7 11/28/89 12:32:03 WEAPON: STINGER
SQUAD LEADER SSN =
GUNNER SSN =

Pop-up Target System (PTS) Operations

The Pop-up Helicopter Target System Control Console is shown in Figure 59; the entire PTS is depicted in Figure 60. To turn on the system and verify operations follow the procedure below. To shut down the system, perform this procedure in reverse order. For more information, refer to the PTS Operations and Maintenance Reference Manual.

- Close drain plugs on base of mast and bottom (right rear corner) of trailer (open drain plugs when not in use).
- Ensure that there is sufficient oil and gasoline and check filters (refer to generator manual on pre-operations checks; see also Figure 28).
- Plug in the antenna cable to the antenna mast assembly and screw on the cable collar. Position the mast assembly at least 20 feet away from the PTS.
- Connect the positive (red) amplifier wire to the battery.
- Turn generator switch to "On", wait ten seconds, and turn switch to "Start" (ignition). Allow generator to warm up for a minute or so (evidenced by a drop in engine noise level).
- Turn on output circuit breaker.
- Verify pneumatic pressure is raised to 100 psi. The fan on compressor unit will be operating whenever pressure is lower; when pressure stabilizes, compressor (fan) stops.
- Turn on the control box by moving the toggle switch in the back to the up ("On") position. Move the rocker switch on the left front of the box to the "On" position (rotator). Move the rocker switch on the bottom right front of the box to the "Reset" position and release it to the "On" position (modem). Ensure the toggle switch in the lower middle of the front of the box is in the center position (elevator).
- Check operation of the target skin orientation rotator by turning the rotator knob clockwise and counter-clockwise. Verify that the target skin moves right and left.
- Check operation of the "up" and "down" mechanism by moving the toggle switch at the upper middle of the front of the box up and then down. Verify that the target raises up all the way and that the rotor blade rotates before lowering the target. The switch should then remain in the center position.
- To change target model skins, unplug the drill from the extension cord; remove the rotor blade using the drill key; and unbolt the four bolts that connect the top of the skin to the mast. Remove the skin and remount another skin, reversing the above procedure.

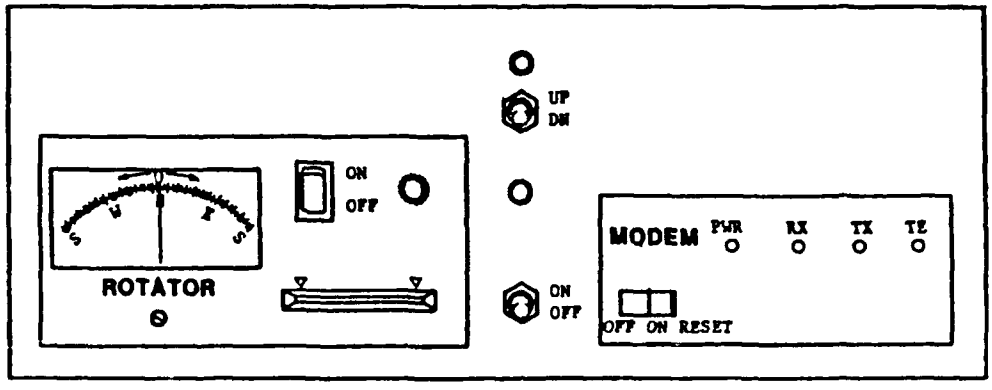
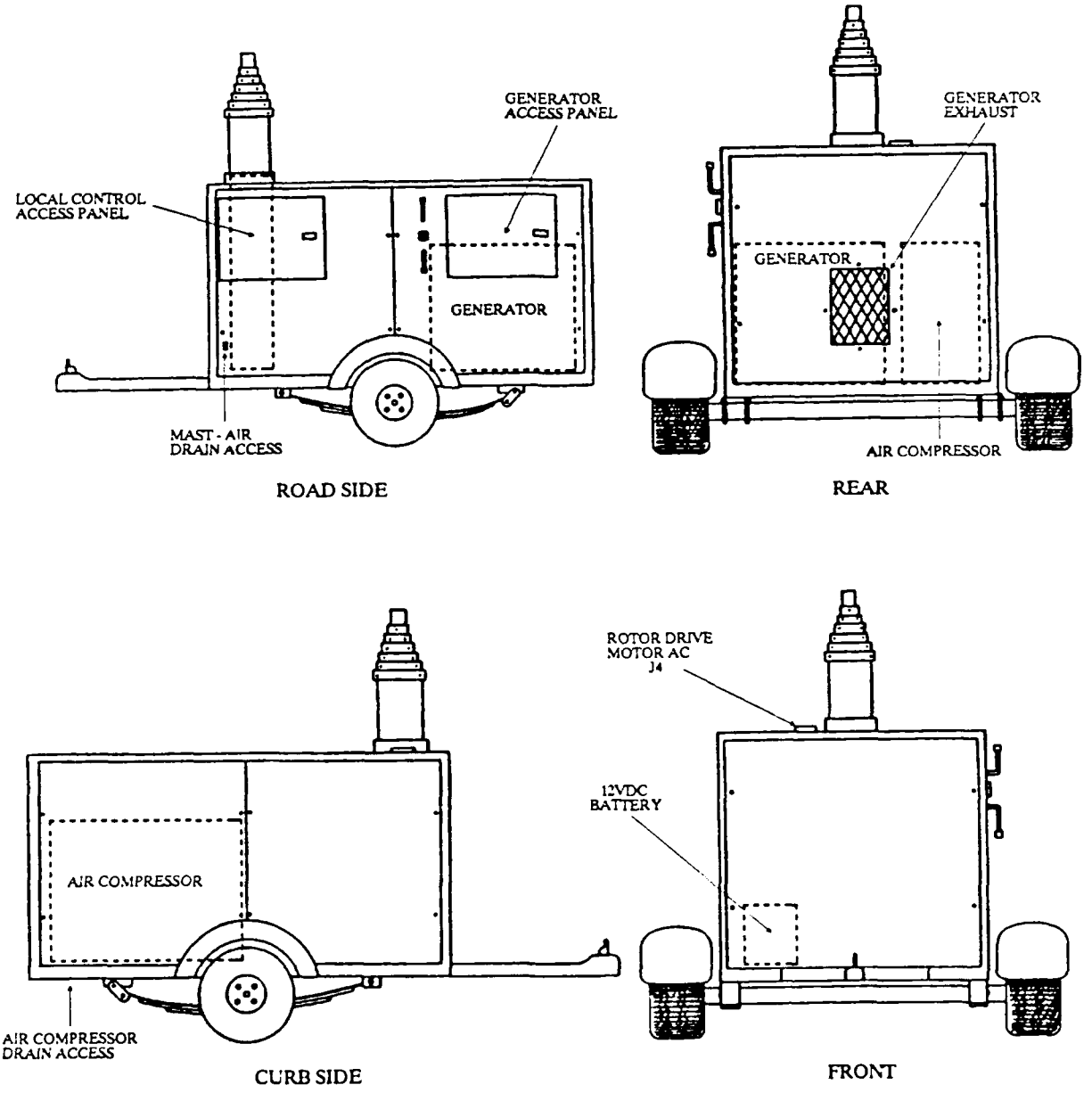


Figure 59. Pop-Up Helicopter Target System Control Console



Note: Attach and detach access panels using a nut-driver and sheet metal screws.

Figure 60. Pop-Up Helicopter Target System

Flying Target System (FTS) Operations

The FTS requires experienced pilots to fly and maintain the targets. This section presents a brief overview of FTS operations. For more information refer to the FTS Operations and Maintenance Reference Manual. Do not attempt to perform any of these tasks without extensive prior experience.

- Ensure that all aircraft to be flown for the following day are serviced and readied for flight the previous day. This includes charging the receiver and transmitter batteries, performing engine tests, and inspecting the aircraft, RF datalinks, and launcher.
- Recheck all aircraft to be flown before deploying them to launch position.
- Perform pilot net radio communications check and RF aircraft control datalink checks.
- Load aircraft, aircraft components, and auxiliary equipment on aircraft transportation.
- Deploy launcher, aircraft and accessories, pilot (launch) crew, and radio equipment to aircraft launch and recovery position.
- Unload aircraft, assemble them, and place them in the order they will be flown. Ensure the first aircraft has retro-reflectors securely fastened to wingtips and fuselage. Set up and verify RF aircraft controls are operational (e.g., each pilot ensures ailerons, elevator, and throttle responds to commands). Ensure RCS receives position-location information from the aircraft.
- Deploy mobile pilot team(s) to predesignated positions down range. Verify radio communications with launch and the RCS. Set up RF aircraft control antenna.
- Prepare aircraft launcher for operations.
- Place aircraft onto launcher. Complete pre-flight checks. Stand clear of launcher before launching aircraft.
- Launch aircraft into the wind. Acknowledge that aircraft is airborne using the pilot radio net.
- Set aircraft "trims" and acknowledge over pilot radio net.
- Fly aircraft according to prescripted flight path and perform pilot handoff procedures when applicable. Perform "switch-back" procedures if RF control is lost or intermittent. Ensure the radio net is open to allow for communication of critical flight information (handoff, switch-back, etc.).
- Land the aircraft when the flight is over and inspect it for damage.

Maintenance and Supply

Maintenance Support

Site representative. If a local contractor representative is available, he will be the primary source of assistance. He is knowledgeable about the configuration of the RTS, its applications, and special requirements of the user he serves. The representative is backed by special support resources within his organization.

Organizational. For large organizations, which utilize one or more RTS systems, the best source of maintenance assistance may be within this organization. Large organizations will often designate central support personnel for organizational maintenance, supply, and provisioning. Support personnel within this organization may call upon the special resources available from the contractor.

Depot (contractor). High quality, professional hardware and software maintenance support is provided through the local onsite representatives, at Repair Centers, and via the network of sales and service offices. When sending any equipment to a contractor Field Repair Center follow the packing guidelines given below.

Packing guidelines for returning equipment. Follow these packing instructions when sending in RTS equipment for repair or replacement:

- Remove any consumable supplies from the component.
- Use the original shipping or storage container.
- Include a completed Service Information Form.
- Include the Return Material Number.
- Include any examples or notes on the failure.
- Obtain insurance coverage for the equipment.

Maintenance agreements. Several types of maintenance agreements are available to meet a wide range of needs.

- The Field Repair Maintenance Agreement allows prime items to be sent to a nearby Field Repair Center, where they are repaired or replaced within three (3) working days. This contract is priced below the average cost-per-incident service. It is a high priority service, where costs are pre-budgeted with no chance of unexpected expense.

- The On-Site Maintenance Agreements are available with several levels of response time and coverage. The user simply selects the support level best suited to anticipated system usage. For example, if located within 100 miles of a primary service office, next work-day support is available. Extended coverage hours and extended travel beyond 100 miles are available for an additional fee on most on-site service agreements.

- The Volume On-Site Maintenance Agreement is offered to organizations with multiple RTSs. It provides scheduled weekly repair visits at a central location, if within 100 miles of a contractor Service Center. A contract can be written for any number of RTSs.

- Courier Return Service allows the user to take advantage of the contractor's low cost return service by providing on-site pick-up of faulty RTS components. The designated courier picks up and delivers equipment to the Service Center and delivers replacement parts to maintain operations. Courier Return Service is available only in designated areas for specific products in effect at the time of service. Contact the nearest Field Repair Center to determine eligibility for this service.

Ninety day limited warranty. The contractor provides a warranty of all hardware products for a period of ninety days from date of acceptance by the user. During the warranty period, the contractor will repair or replace any components which are found to be defective. Bring or send the failed piece of equipment to an authorized Repair Center.

To obtain warranty service, items are usually returned to a service facility. The customer shall pay shipping charges for products returned for warranty service and the contractor shall pay for the return of the products to the customer. However, the customer shall pay all shipping charges, duties, and taxes for products returned for repair or replacement from another country. However, the contractor may repair faulty components on-site at the option of the customer. The customer is responsible for travel charges when on-site repair is requested.

The warranty does not apply to defects resulting from improper or inadequate maintenance by the customer, customer-supplied software or interfacing, unauthorized modification or misuse, operation outside of environmental specifications for the product, operation of non-supported media or supplies, improper site selection and preparation, or live fire or maneuver damage.

Provisioning

RTS is designed to work with rather particular equipment; substitutions of recommended supplies and spares can affect the reliability, availability, and maintainability of the system. Refer to the various hardware manuals referenced at the end of this chapter for recommended supplies and spares. Some of the general supplies that should be obtained in sufficient quantities include printer paper and ribbons, FTS propellers, a variety of fuses, and a variety of batteries (for radios, PTS, FTS transmitters and receivers, etc.).

Related User Documentation

The ADA engagement performance criteria, which were developed and validated (Barber, in press), are expected to appear in future versions of the US Army Standards for Weapons Training (Department of the Army Headquarters, 1988). This manual is a reference guide to evaluating soldiers according to known standards of performance and focusing training where deficiencies exist.

There are also a number of reference manuals associated with the hardware and software components. These vendor manuals provide additional information on operations, preventive maintenance of the equipment, spares, and supplies. The list which follows includes important documentation that should be reviewed prior to attempting system operations.

HARDWARE MANUALS

- DataWorld Portacomp II 286 User's Guide (RCS, DAS and PLS computers)
- Onguard PC Series Uninterruptable Power System User's Manual
- ESTeem Modem User's Manual
- Okidata Microline 390 and 391 Printers Reference Guide
- VideoTek Inc. Service Manual (PLS camera monitor)
- Installation, Operation, and Maintenance Manual for 1830 and 1860 Series Environmental CCD NTSC Color Cameras (PLS camera)
- Installation and Operation Manual PT1250DC Heavy Duty Pan Tilt (PLS laser and camera pan/tilt assembly)
- SAAB BT-53 Anti-Aircraft Missile Simulator Operator's and Maintenance Manual (PLS laser and ballistics simulator)
- SAAB BT-53 Laser System Test and Calibration Procedures
- Honda EX3300S/4500S Owner's Manual (system and pop-up helicopter target generators)
- PTS Operations and Maintenance Reference Manual
- FTS Operations and Maintenance Reference Manual

SOFTWARE MANUALS

- dBase III
- DB Files Reference Guide
- DB2C Function Library
- DT2811 Data Translation Reference Manual
- DigiBoard Installation Guide Reference Manual
- Microsoft Library (several manuals)
- MS/DOS Utilities
- MS Assembler Reference Manual
- Greenleaf Communications Library
- "C" Worthy Interface Library
- Polymake User's Manual
- Programmer's PC Sourcebook

Glossary

The following terms and acronyms are used throughout this manual. It is recommended that the users familiarize themselves with these terms.

Calibration -- The PTS targets must be calibrated in terms of the elapsed time to unmask, to be fully raised, and to mask. This is to ensure that the availability times for all presented helicopter targets are the same (i.e., availability equates to line-of-sight from the weapon position for all targets regardless of the time it takes to raise and its elevation above the terrain).

Computer -- This refers to the computer systems which host the RCS, DAS, and PLS (i.e., the hardware which "controls" system functions at that station and the device from which the operator "controls" the data inputs).

Coordinates -- This refers to the position-location of system components in terms of a grid and associated "X" and "Y" coordinates. For example, the weapon (i.e., the DAS) is usually given the coordinates 0,0.

DAS -- Data Acquisition Station

Data Acquisition Station -- The RTS station which captures weapon responses and from which squad leader responses are entered by the operator during a scenario. This station uploads all engagement events to the RCS and provides feedback on these events after any scenario when requested.

Flying Target System -- Refers to flying targets which are remotely piloted by experienced pilots on the ground, using radio frequency transmitters and receivers.

FTS -- Flying Target System

Highlighter -- All interactive menus used during the set-up and operation of the system display a highlighter. This highlighter appears as reverse video (i.e., a negative image with respect to the contrast of the rest of the display). The highlighted option is the one which will be selected if the operator presses the < ENTER > key. The highlighter can be moved using the arrow keys.

Instructor-Evaluator -- This is the person who is in charge of the training and qualification of SHORAD personnel. Typically this individual is also the DAS operator who performs data collection tasks and provides feedback to the exercising weapon crew.

Laser Ballistics Simulator -- This device can be mounted on 20mm gun systems (i.e., Vulcan or PIVADS) to provide hit-miss engagement effects scoring and to simulate tracer round flyout to the engaged target.

LBS -- Laser Ballistics Simulator

Modem -- The modems provide datalink communications between the RCS and PTS via radio frequency.

Pan-Tilt Assembly -- This device is used to orient the PLS laser in elevation and azimuth.

PHTS -- PTS

PLS -- Position-Location System

Pop-up Target System -- This system presents helicopter targets simulating a pop-up and hover maneuver. Pneumatic stand-lift mechanisms, remotely controlled via radio-frequency commands, raise a target above its terrain mask for a predesignated period of time before lowering it again.

Position-Location Station -- This system provides the actual position of a flying target, in terms of slant range from the weapon (and "X", "Y", and "Z" coordinates), every 1/2 second. The range of the aircraft is ascribed to every event performed by the weapon crew during realtime for immediate feedback and scoring.

Primary Target Line -- The PTL is assigned in the crew's Operations Order (OPORD) and is usually at the center of their assigned search sector, which is also defined in the OPORD. In RTS, the PTL is usually the 12 o'clock position, or directly down range relative to the crew.

PTL -- Primary Target Line

PTS -- Pop-up Target System

Range Control Station -- This station is the control center for the system during training and test operations. The RCS is used to perform system set-up procedures, perform preliminary tests, initialize and execute scenarios, perform data offload, and execute scoring functions. The RCS operator usually supervises all range functions associated with the PLS, FTS, and PTS, and communicates and coordinates with pilots and personnel down range.

RCS -- Range Control Station

Registration -- This refers to the position-location of system components in terms of "X" and "Y" coordinates. The entire system is registered resulting in the location of the exact position of all critical components, relative to the DAS.

Retro-reflector -- These devices reflect the projected laser beam back to the PLS in order to derive the location coordinates of the object upon which the reflector is mounted (such as a long pole, PTS, or FTS). The reflectors are used whenever the PLS is being employed as a rangefinder, ballistics simulator, or registration device. They are attached to pods or brackets for easy mounting on targets.

Scenario -- This refers to the specifications that will be executed in conjunction with single or multiple target presentations. The scenario defines which targets will appear, where, when, for how long, at what orientation and range, in what sequence, etc. The scenario can also specify command and control conditions (e.g., alerting and cuing, weapons control status, interrogation response, etc.), difficulty level, terrain conditions, and so forth.

Spotter -- This person is used down range during registration of system components. A retro-reflector mounted on a long pole is carried by the spotter to the various positions to be registered, so that the PLS laser can position-locate them. Once verified, these positions are physically marked by the spotter so that there will be no confusion as to where to emplace the equipment.

Test -- A number of test functions are performed every day by the RCS and DAS operators before commencing operations. The RCS operator tests the PTS and PLS. The DAS operator tests the weapon.

Uninterruptable Power Supply -- Protects nonlinear power supplies in computer systems and their data from the harmful effects of blackouts, brownouts, surges, sags, spikes, and transients (i.e., anomalies in the power flow). It provides extended backup during sustained low voltage by continuously converting raw utility power from AC to DC and back to pure AC power through its inverter (via pulse width modulation). The UPS provides uninterruptable pure power to all critical devices resulting in improved system reliability.

UPS -- Uninterruptable Power Supply

Weapon System Interface -- This device interfaces the weapon to the DAS. It is also used to simulate weapon inputs to verify that the DAS is receiving these inputs prior to hooking up the weapon.

WSI -- Weapon System Interface

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